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ABSTRACT

This document contains 39 papers and 13 poster presentations from a conference on technological education and national development. The following are among the papers included: "The Future of Technological Education and Vocational Education: UNESCO's (United Nations Educational Scientific and Cultural Organization's) Perspective" (Adnan Badran); "Vocational Technical Education and Training in Palestine--A Proposal for a National Strategy" (Hisham Kouhail); "Women and Education in Lebanon" (Bahia Hariri); "Higher Education and the Emerging Role of Women in the UAE (United Arab Emirates)" (Howard E. Reed); "The Impact of Rapid World Technological Changes on the Polytechnic in Africa in the 1990s and Beyond" (Elifa Ngoma); "The National Labour Force: Self-Sufficiency and Development: Role of Technical Education and Vocational Training--the Experience of the Sultanate of Oman" (Mohammed bin Hafeedh Al-Dhahab); "Cultural Diversity in a Tertiary Institution: Threat or Opportunity" (Kobus Vorster); "The Need for Industrial Human Resources Development in Developing Countries" (Shadrack Njah Ndam); "Prospects for Trade and Industry in the UAE" (Anis Al Jallaf); "Reforming Technological Education" (Nahayah Mabarak Al Nahayan); "School-to-Work Policy

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Insights from Recent International Developments" (David Stern); "Competency-Based Education--Neither a Panacea nor a Pariah" (John A. Bowden); "Reforming Technological Education--Imperatives for Change" (John Hillier); "Creating Motivating Interactive Learning Environments" (John Hedberg); "Capitalising on Interactive Multimedia Technologies in Dynamic Environments" (James A. Senn); "Assuring Quality in International Education: An Institutional Perspective" (Keith C. Short); "Operating Decentralised Education Systems and Maintaining Standards: Experience in England" (William Stubbs); "Meeting the Work Force Demands of the Future Market" (Mohammed Al Abbar); "The Power of Partnerships" (Tayeb A. Kamali); "The International Experience of Technological Training" (Maurice Gross); "Partnerships in Training through National and International Networking" (Jeff Gunningham); "The Dual Community--Training Technicians and Business Involvement: An International Perspective" (Gert Loose); "Strengthening Professional Pilot Education through Academic/Industry Collaboration" (Thomas J. Connolly); "Modern Geomatics and National Development" (D.R. Fraser Taylor); and "English for Technology" (Graham Elliott). Many papers contain substantial bibliographies. (MN)

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Conference on

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6 to 8 April, 1997

REPORT OF PROCEEDINGS

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TEND 97

Conference on

Technological Education

and National Development

6 to 8 April, 1997

REPORT OF PROCEEDINGS

Preface

The rapid acceleration of technological change has emphasised structural weaknesses in modern and modernising economies throughout the world. Among the foremost of these weaknesses is the apparent inability of technological training and vocational education to keep pace with the rapidity of change and the consequent dilution of the pool of professional and skilled labour which is essential for national economic development.

The first conference in the United Arab Emirates on Technological Education and National Development - TEND 97 - directly addressed these issues, bringing together interested participants from all over the world. They came from countries as diverse as Papua New Guinea and Canada, Finland and Kuwait, Sri Lanka and Ireland, all sharing a common concern the improvement of their people's participation in their own economic development.

Since this was the first conference of its kind in the Arabian Gulf region, there was no Call for Papers. Presenters were selected and invited with an eye to providing the widest possible coverage of interests from industry, government and academic institutions and to foster and encourage dialogue between all participants. In this Report of Proceedings, consequently, the reader will find political polemic, academic discourse both lively and measured and proud recording of achievements together with acknowledgement of past mistakes. Participants came to learn from each other and, from the tenor of their comments at the end of the conference, they were more than satisfied.

The Proceedings are laid out in the order of their progress. Academic papers have been re-formatted to a uniform style using the Chicago Manual of Style and they and transcripts of verbal presentations have been typeset in 11 point Century Schoolbook to ensure maximum readability and economy of size.

To facilitate ordering this publication, an International Serial Book Number (ISBM) has been applied for.

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Welcoming Speech

HE Sheikh Nahayan Mabarak Al Nahayan
UAE Minister for Higher Education and Scientific Research
Chancellor of the Higher Colleges of Technology

Your Excellencies, Esteemed guests, Conference participants,. Ladies and gentlemen: Good morning.

I am very pleased to welcome you to the United Arab Emirates and to this conference on the impact of technological education on national development. I wish for you an enjoyable and productive stay in our beautiful capital city. Now that our somewhat unexpected spring showers have ended, we can promise you, with confidence, a warm and sunny sojourn with us.

Your presence here this morning at this international conference emphasises an important fact: the challenges and opportunities that surround educational policy and practice are experienced everywhere in the world. I am confident that the conference will stimulate discussion about issues of common concern in the field of technical and vocational education. By the end of our sessions, I believe that we will be able to identify benefits of our work together that will apply individually and collectively to educational systems of all countries of the world.

It is my distinct honour and privilege to convey to you the greetings and welcome of HH, The President, Sheikh Zayed bin Sultan Al-Nahayan, the gracious Patron of this conference. Under his support and guidance, it has been a national goal to develop a full spectrum of educational programmes in the U.A.E. and to take every opportunity to improve the quality of these programmes to meet or exceed world standards. The President has always stressed "investment in man" as the foundation of our national efforts for development and progress. To Sheikh Zayed, education is the essential mechanism to give meaning to our national purpose.

Ladies and Gentlemen: We, in the U.A.E., take special interest in this conference for two reasons:

First: the focus of the conference is education, a process that is at the heart of the development of our country.

Second: this is an international conference. The U.A.E. is open to consideration of all ideas of the world. Conferences such as this give us an opportunity to sift through international ideas and to choose those which can be adapted to improve our national institutions. International discussions allow us to make our contributions to the major world-wide issues of the day as well and thus to establish our place among the nations of the world. The substance of the various sessions of this conference and the expertise and stature of the presenters and other participants will provide us with excellent opportunities both to give and to receive from the international dialogue.

Ladies and Gentlemen: Anyone who undertakes to list the goals of education in our world will come up with a long list in a short time. There is, I believe, general agreement that education has two primary purposes. It must provide the skills required to permit each individual to function productively during his or her lifetime. And it must provide the knowledge from the past and information of the present that form the intellectual, ethical and moral context within which people will live their lives.

All students require certain basic skills that are fundamental to all areas of human activity. Likewise, all professions proceed on a set of skills determined by world-wide standards and practices. These skills prepare the student for useful and productive occupations so that they can contribute to the economic and social development of the nation.

Important as such skill development may be, we require more of the education system in order to maintain a healthy economy and a thriving culture. The effective and productive citizen will also need to know the context within which his world currently operates, the source and content of the technologies on which his activities are based. In addition, he must have a basis for adapting to changes that occur during his lifetime and, most important of all, he must have the ability to contribute to the developments which will continue over his lifetime. The effective citizen must also be acknowledgeable about the norms and values of his society as well as having awareness of, and commitment to, his national culture and heritage. Thus we require an educational system that is dedicated to community enrichment, to competence and commitment in the workplace and to broad knowledge, wisdom and strength of character for every student.

Ladies and Gentlemen: It is critical that we examine the implications of these educational principles for technological education programmes. Technological education has become essential to our ability to respond to today's economic challenges, as economic and social conditions everywhere continue to create the demand for its relevance and effectiveness.

For technological education to contribute successfully to national development requires the active participation of many sectors of society, including higher education, the business community and political leadership. In addition, issues of societal attitudes, curriculum, resources and support, linkages, assessment and job prospects must be continuously addressed.

Relevance and effectiveness of technological education must also be planned against the background of each country's conditions of development. Poor decisions can cause serious problems by creating unrealistic expectations and wasting valuable resources.

I take this opportunity to express my hope that this conference will be an important step in our efforts to improve the quality of technological education everywhere. I wish you all the success in your efforts.

Once again, let me welcome you to the United Arab Emirates. We look forward to learning about your discussions and deliberations. As I have noted, the U.A.E. has developed an effective education system which is under constant assessment and improvement. This conference should help us in our endeavours to expand and improve.

Thank you and best wishes.

The Future of Technological and Vocational Education: UNESCO's Perspective

HE Dr. Adnan Badran

Deputy Director-General of UNESCO

Your Excellency Sheikh Nahayan bin Mabarak Al Nahayan, Minister of Higher Education and Scientific Research and Chancellor of the Higher Colleges of Technology;

Distinguished Participants;

Ladies and Gentlemen,

It is my great pleasure, on behalf of Mr. Federico Mayor, Director-General of UNESCO, to address the opening session of TEND 97. The Director-General very much wishes to be here himself for this important event. Unfortunately, other United Nations commitments have made it impossible for him to attend this conference personally. He asked me to convey his regrets and he wishes TEND 97 great success.

Your Highness,

YourExcellency,

Ladies and Gentlemen,

UNESCO highly appreciates and supports the initiative taken by the United Arab Emirates and its Higher Colleges of Technology to organise TEND 97, a conference that examines the impact of technological education on national development. This significant event is taking place at a crucial moment, when we are at the threshold of the new century and when all countries are facing serious challenges posed by the globalisation of the world economy and the rapid development of technologies.

Last year, the international Commission on Education for the Twenty-First Century, chaired by the former European Commission President, Jacques Delors, prepared and published its report entitled: "Learning: The Treasure Within." Referring to the advancement of technology and its impact on education, the report stated:

> ...in a world increasingly dominated by technology, emphasis must be placed on ways both to use technology in the service of education and to prepare people to master it for living and working. Getting the reform strategies right, by a broad-based dialogue, and by increasing responsibility and involvement of stakeholders at every level, will be a crucial element of educational renewal.

Fortunately, TEND 97 is providing us today with an exceptional opportunity, an international forum, to discuss and exchange our views on future strategies for further development and renovation of this important sector of education.

What is the impact of the globalisation of the world economy and the development of technologies on industry and what we do to improve technological and vocational education in order to cope with this new phenomenon? I should like to share some of our perspectives with you—perspectives that are drawn from the rich and varied experience we have gained along with our Member States.

To be competitive in the global economy, a country has to educate the bulk of its citizens up to a significant level, providing appropriate technological and vocational education so as to make its work-force at all levels highly skilled. Modern technologies have helped to establish, in many countries, comprehensive production systems based on highly qualified work, complex job assignments and teamwork structures. Competent personnel are essential in handling such modern and flexible production technology. They are required to solve intricately complex problems. Specialised knowledge limited to one workplace is no longer sufficient. Capacity and flexibility, along with willingness, are now decisive skills. Technological and vocational education should, therefore, provide more generalizable skills in order to prepare the labour force for the rapidly changing world of work. The skills developed will be used by people who have particular sets of values. Therefore, any development of technological skills must be paralleled by the development of people as people: their attitudes, values and levels of appreciation. In this connection, the concept of key competencies has received increasing attention. These competencies may include, collection and analysing information, planning activities, working with partners, using technology, and so forth. Such development is an important component of the concept of life-long education, which is a key theme of UNESCO.

Technological and vocational education should be provided in the most flexible manner together with the new information and communication technology, which offers means to make it possible. Today, technological and vocational education and training can be obtained in school, at the work place or even at home. However, the school population should not be the only target group. In both the developed and developing countries, several disadvantaged social groups exist, such as unemployed youth, school drop-outs, demobilised soldiers (in post-conflict nations), and so on, who undoubtedly are in great need, and should be in a position to accede to technological and vocational education, for the sake of the country's socio-economic development.

In order to reach them, education and training have to be offered through both formal and non-formal settings. As flexibility is in such high demand, the curricula of technological and vocational education, in many countries, tend to be modular, suiting the specific individual's needs and employment circumstances.

The rapid advancement of technology also greatly affects the delivery system of technological and vocational education. The utilisation of new informatics technology has made the access to this education easier and training possible. Technology will be more and more powerful, both hardware and software will be more convenient to use, and have more functions. Standardisation will mean faster and cheaper development of learning materials. The move from analogue to digital will increase the possibility to exchange and transmit learning materials through the computer network. We, therefore, have to plan for an intelligent use of the new information technology in order to improve the access to technological and vocational education as a life-long learning process. This implies a considerable amount of effort from all parties involved. Decision-makers have to know how to make decisions related to investment in new technologies. The teacher's role will change considerably and will be that of an integrator of learning activities. They have to be trained or re-trained accordingly. Learners will have to become more active in the learning process, helped by teachers and by new technologies in their new roles. Technological educators will also have to work closely with software manufacturers constantly to offer easy-to-use teaching/learning materials and programmes. To a large extent, the new information technology will contribute to the development of both the necessary attitudes and educational opportunities for life-long learning. We have to be well prepared for this rapidly advancing upheaval.

To be productive and demand-driven, in order to meet the changing needs of industry and the society as a whole, the organisation and management of technological and vocational educational systems need reform. No more than a decade ago, technological and vocational education was mainly delivered by public providers. In recent years, reviews of technological and vocational education systems were undertaken in many countries in the light of attempts to create a demand-driven market situation with both public and private providers involved.

To make the system more responsive to the real needs of enterprises, several approaches have been proposed including, on the one hand, to support with government funding, private providers, and on the other, to give individual institutions more autonomy to enable them to compete with each other for students and funds. The secret of success in such a new order will be offering the needed service to clients. Needless to say, that to what limit this reform should go will have to depend on each country's understanding of the role of the government in technological and vocational education. In our opinion, the government should be encouraged to make an even stronger commitment in developing policy, allocating resources and monitoring performance, which will keep technological and vocational education moving in the direction the country requires.

Technological and vocational education, by its nature, has to be connected closely with the world of work, in particular, the industry and enterprises. The relationship between technological/vocational education and industry has traditionally, in many countries, not been a close one. This is in the process of changing. Companies are now well aware that their competitiveness depends upon the level of skill of their employees. They are taking a much closer interest in what suppliers of technological and vocational education have to offer. Many approaches have been identified to strengthen the link between industry and technological/vocational education—such as apprenticeship, involvement of industry in the operation of technological/vocational education institutions, national and regional industry training bodies. This trend will continue and governments should be encouraged to provide the impetus for the establishment of such linkage.

Your Highness,

YourExcellency,

Ladies and Gentlemen,

As with most changes, ideas from one part of the world very quickly become, through global communications and meetings such as this, part of a changed agenda in another. UNESCO, as an international organisation promoting intellectual exchanges, has been active during the past several decades in facilitating international co-operation in the field of technological and vocational education. It is noteworthy, here, to mention two documents in this field: The Revised Recommendations Concerning Technical and Vocational Education (1994) and the Convention on Technical and Vocational Education (1989). Our Member

States have greatly benefited from these two international standard-setting instruments.

Aiming to enhance UNESCO's contribution to the development of technological and vocational education in its Member States, UNESCO, in 1992, launched its International Project on Technical and Vocational Education (UNEVOC). The Project was designed firstly, to foster international exchange of ideas on policy issues; secondly, to strengthen national research and development capabilities; and thirdly, to facilitate access to information through networks.

During the past five years, the Project provided sufficient documents on existing technological and vocational education systems in various countries for international comparisons and offered forums for discussing national policies and practices in this field. A large number of national and regional training activities and joint projects were supported through the Project in order to improve the national research and development capabilities in the Member States. The application of new training technologies has been receiving additional attention in this process. An international network composed of 140 institutions in 100 countries was established to strengthen international co-operation. Efforts are being made to connect these institutions by the current information technology available, while extensive information and relevant data are being disseminated through this network. Since it was launched, the UNEVOC Project has received enthusiastic support from UNESCO's Member States. More than 130 countries have participated in the Project activities in one way or another.

Ten years ago, UNESCO organised the First World Congress on Technical and Vocational Education in Berlin, Germany (1987). Since then, many Member States have expressed their desire to have another opportunity to discuss the future of technological and vocational education, at this crucial turn of the century. Answering this call, UNESCO is planning to organise the Second World Congress. The Government of the Republic of Korea has already offered to host this Congress in Seoul in 1999. This initiative demonstrates yet another contribution that UNESCO is very keen to make towards the reform of technological and vocational educational and national development of its Member States.

Your Highness,
YourExcellency
Ladies and Gentlemen,

On behalf of Mr. Federico Mayor, I wish TEND 97 every success. I may say that the outcome of this important event is awaited with greatest interest. The impetus emanating from TEND 97 should benefit many countries by providing national policy-makers with fresh perspectives on the role of technological education in national development. We, in UNESCO, will also examine the conclusions of TEND 97, and will draw from them all that can be learned with a view to preparing UNESCO's future programme in this field.

Thank you, the United Arab Emirates and the Higher Colleges of Technology, for this initiative and its excellent organisation.

Theme Address

Dr. Hisham Kouhail
Deputy Minister of Higher Education for Palestine
on behalf of Dr. Hanan Ashrawi,
Minister of Higher Education of the Palestinian Authority

Good morning, Your Excellencies, distinguished participants, ladies and gentlemen:

I am very honoured to be here today with you in the UAE, and at this conference on the impact of technological education on national development. On behalf of Dr. Hanan Ashrawi, Minister of the Palestinian Ministry of Higher Education, allow me to convey our deep appreciation to H H Sheikh Zayed, the Government and the people of the UAE .

Dr. Ashrawi asked me convey her apologies for not being able to be with you here today. I am sure that you all appreciate the emergency situation that we are going through at such a critical period of time. She was asked by President Arafat to join a delegation to the US for intensive talks, to try to break the present impasse in the peace process. Dr. Ashrawi asked me to deliver this speech and also to convey her best wishes for a successful conference.

Science, engineering and technology affect every aspect of our daily life. They are the major engine since they are developing at an ever-increasing pace. The social and economic implications of this are the main reason why governments world-wide invest in science, engineering and technology. One phenomenon of this century is the compression of time as a result of the accelerated pace of technological change, leading to rapid and pervasive shortcomings both in education and training and in the skilled work force. Such shortcomings require intervention in the form of networking, adjustment and upgrading, continuing life-long education and the partnership between economic forces and educational institutions. This integrated approach has become inevitable, particularly in research, science and technology and the creation of a modular system of education and training with an inherent capacity for adaptation.

Education used to be a social service rather than a productive activity. This perception should change if we are to compete with the global economy. Education should be looked at as an investment which aims at higher productivity and socio-economic development, on the national level. If we are to compete successfully in an era of rapid economic and technological change, we require not only capital investment but also a work force that has the flexibility to acquire new skills for new jobs, as the structures of economies and occupations change.

We therefore need to foster the excellence of technological education and training as a major factor affecting the competitiveness of industry and its vital contribution to wealth creation and the people's quality of life. An excellence built up through the work of university, research councils, technical colleges and other organisations over a long period. It is imperative that we should place high importance on the creation of a viable and effective quality system of higher education, which is crucial for maximising human resources, in order to facilitate infrastructure building in our region and to support current economic developments. Policies therefore, should be focused on the development of a higher educational system which is tuned to the realities and needs of our populations and which is both equitable and competitive, on a quality and service par with other regional and international systems.

The Palestinian Ministry of Higher Education, like other Palestinian organisations, is facing the challenge of moving into the twenty-first century whilst still combating a number of adverse conditions, which have resulted from nearly thirty years of occupation and the absence of national government. The Ministry of Higher Education places importance on the creation of a viable and effective quality system of higher education which is crucial for maximising human resources, in order to facilitate infrastructure building in Palestine.

The Ministry of Higher Education has inherited a run-down system of technical vocational education and training, designed to train low-skilled workers for the Israeli labour market. A technical vocational and educational system that is teaching according to a curriculum that is twenty-six years old, that utilises equipment and buildings that are vastly outdated or obsolete. For Palestinians in general and the Ministry of Higher Education in particular, the challenge lies in updating and upgrading the educational system and raising its standards in order to meet with the needs of the Palestinian society and its aspirations.

The Ministry, in co-ordination with the Ministry of Education and the Ministry of Labour, is working towards the development of a unified system for technical education. The three ministries produced a strategy paper which will be at your disposal during the conference. The strategy paper addresses certain issues of great importance to the development of technological education and training. It basically aims at improving relevancy, effectiveness and efficiency through the establishment of closer and coherent links with universities, technical colleges, industries and research councils.

- Developing technological educational policies to meet the country's future needs and to enhance our capacity to create the economic growth in the broadest sense.
- Maintaining the excellence of science, engineering and technology to advance knowledge, increase understanding and produce highly educated and trained human resources.
- Improving public awareness and understanding of the contribution of technological education and training, by applying knowledge of social trends and factors to the better understanding of markets, risks, perception and the human impact of new technology.
- Maximising effectiveness of our regional and international links and co-operation, reaffirming government commitments in developing the excellence of science and engineering and the educational system.
- Promoting the participation of women, since securing quality of opportunity for women is a vital part of the process of maintaining the excellence of science engineering and technology.
- Thus making use of skilled knowledge and know-how of all scientists, engineers and technologists regardless of gender.

With the dynamism of the peace process, and the impetus expected by the economic development, since the demand for different skills is often hard to predict, a flexible approach becomes inevitable. Flexibility is addressed within the system, at all levels, and it is based on the following guidelines:

- Technical education should go along with the needs and changes in the technical market.
- Technical education should lead the majority of trainees to the labour market. However, students will have the opportunity for higher education.
- Technical education should attract a new group of students, and should provide both formal and informal education for effective use of existing facilities.

In this regard, the proposed system advocates the following:

1. The production of a flexible system to cater to all levels of students, including those who aspire to a university degree.
2. The production of a flexible system regarding admission, graduation requirements and certification.
3. The introduction of a system within which industry, trade and business can play a vital role in the decision making process.
4. The introduction of a mechanism which would ensure a coherent link between secondary vocational and technical education and higher education
5. The introduction of a system which enhances the establishment of academic ties between vocational technical institutions and universities in the field of applied research.
6. The introduction of a system which can be easily updated or adapted to respond to change.

Ladies and gentlemen, Palestinians are very keen to examine experiences from all over the world. This is why we are here today; to learn to share our ideas and to discuss common problems. We thank you for giving us the opportunity to participate in this very important forum.

Vocational Technical Education and Training in Palestine— A Proposal for a National Strategy

Dr. Hisham Kouhail,
Deputy Minister
Ministry of Higher Education, The Palestine National Authority

1. Aims and Objectives of the Palestinian Vocational Technical Education and Training System

This paper sets out the strategy for the development of a Palestinian Vocational Technical Education and Training (VTET) system.

The Need for Development

The world has experienced an unprecedented and ever increasing rate of technological development in this century. Technology and information technology in particular, have changed the perception of distance and time; the world has become a closely connected village. Not only is financial capital flowing freely around the world, but so are natural resources. The market is dominated by large corporations that decide freely where to invest and thus create jobs and wealth. In deciding where to invest, the main factors of importance are the efficiency of the local labour force (the produced output per salary unit), the political stability of the concerned region, and the political environment for investment (taxation, infrastructure etc.). Thus, as a consequence of the internationalisation of capital, the wealth of a nation depends to an unprecedented degree on the qualifications of its labour force[1]

The Palestine National Authority (PNA) has inherited a run-down system of VTET designed to train low skill workers for the Israeli labour market, a VTET system that is teaching according to curricula that are at least 25 years old, or according to no curricula at all, that utilise equipment and buildings that are vastly outdated or obsolete, and based on teachers and trainers that have received little training, in pedagogic and in vocational skills, and which only have the capacity of training three percent of the student population in any given year. Thus there is no doubt that the system is in serious need of development, if it is to produce graduates that will contribute to the national wealth of Palestine.

Aim and Objective of the Strategy

The aim and objective of the strategy is to create a VTET system that is: Relevant, Flexible, Effective, Efficient, Accessible, Sustainable and which fulfils its general obligations towards the Palestinian society.

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[1] Robert Reich, Secretary of Labour, USA, The Wealth of Nations

Relevance

The VTET system should be relevant, in the sense, that it should provide training that corresponds with the needs of the labour market, i.e. a system that is demand driven. Relevance, thus, is ensured through a system of labour market monitoring, for instance in the form of employer surveys and student tracer studies.

Although the system should primarily be demand driven, it should also serve as a catalyst, in providing a small excess pool of qualified trained persons. This decision is based on a number of arguments:

It is realised that training does not create jobs, but a pool of skilled excess labour might attract investment, which in turn will result in jobs. And as trained persons are better equipped to compete for jobs, and as Palestinians hold a long tradition of working in neighbouring labour markets, training will assist those who wish to obtain a job outside Palestine.

Flexibility

In order to ensure a system that truly contributes to national development, i.e. a system that is demand driven, it will be necessary to create a system that is flexible, and has a high rate of participation of all concerned parties. This is true for two reasons: a) The demand for skills is difficult to predict, as technology develops at an ever increasing rate, and some skills accordingly become obsolete, and others in more demand, and b) The political situation facing Palestine is very unstable, making it very unsure whether or not it will be possible to count on employment of Palestinians in neighbouring labour markets.

Thus flexibility of the system becomes paramount. The system must be capable of quickly adapting itself to the changing demands of the labour markets, if it is to remain relevant. Flexibility is obtained through modularisation[2] of the system, as small modules can easily be changed, abolished or developed in accordance with the perceived needs.

Effectiveness and Efficiency

As resources are scarce, effectiveness and efficiency will be important. The effectiveness of the system, or the extent to which training outputs correspond, especially in terms of quality, to what is intended to produce, is ensured through comprehensive and continuous teacher training and curricula development, and through the adaptation of a system that focuses on exposing students primarily to practical workshop exercises in an industry-like environment, rather than chalk and talk lectures.

The efficiency of the system, or the relationship between inputs and outputs, will be improved by making better use of the existing training institutions, and by integrating the vocational education institutions currently under the authority of the Ministry of Education and the vocational training institutions currently under the Ministry of Labour, and by improving the link between the VTET system and the Community Colleges. Both changes will reduce the present fragmentation of the educational system, and thus improve efficiency.

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[2] For an explanation of what is meant by modularisation and modules, please see the contribution of Lars Igsell to Training in Transition, *Review of Issues and Options* in Vocational Education and Training in the Occupied Palestinian Territories p 42 58.

Sustainability

Any training system that is relevant, flexible, effective and efficient will be sustainable, as long as sufficient financial resources are available. The financing of the Palestinian VTET system will be based on five sources of income: Government funding, a levy/tax on employers, payments from students, income generating activities and donations and grants.

Accessibility

Although it has been decided to create a demand driven system, it is realised that the system has a responsibility towards the weaker groups of society, therefore a system of quotas will be established, giving preference to some students from disadvantaged groups.

General Obligations towards Society

The VTET system, as the rest of the educational system, holds an obligation to assist in the preparation of its students towards life in a democratic society, and towards the contribution to the economy of that society. Accordingly, emphasis will be put on instilling certain values in the students that contribute to that end: Critical and independent thinking, self reliance, pride in being Palestinian and in obtained vocational skills, and finally a set of professional ethics, such as precision, reliability, high quality and honesty.

Main Characteristics of the VTET System:

In accordance with the above, the VTET system will hold the following characteristics:

- A unified national vocational education and training system
- Demand driven, albeit producing a small excess pool of skilled labour
- Based on labour market monitoring
- Participatory: involving all concerned, especially the social partners
- Emphasis on practical learning rather than talk and chalk lectures
- Students with the wish, the ability and who fulfil the requirements may continue to Community College or University after graduation.
- The target groups of the VTET system are:
    - Graduates of the Compulsory General Education system
    - Drop-outs from the General Education system
    - Adults in employment (training and/or retraining)
    - Adults in unemployment (training and/or retraining)
- The training provided will aim primarily at the Palestinian labour market, but also at neighbouring labour markets.
- The system will be modular
- The system will provide primarily job specific modules but also generic modules
- The financing of the system will be based on:
    - Government financing
    - Levy/tax on employers
    - Payments from students
    - Income generating activities
    - Grants and donations from national and international sources

2. Financing VTET

It is considered of utmost importance to establish a sustainable mode of financing the system of VTET. It is recognised that the needs for financing will increase vastly in the coming years, as the capacity of the system will have to be increased many-fold and as the system is in great need of development.

There are five sources for financing the Palestinian VTET system:

Government Contributions to Financing.

This issue is closely linked to the quality of training. The Government has a major interest in the labour market being supplied with trained people to match the quantitative and qualitative demands of employers. Consequently, the Government should contribute to financing the VTET sector from its annual budget, and should regulate the supply of other sources of finance, such as employers and trainees.

Justification for public funding of the VTET sector is based on a number of assumptions: It promotes industrial growth and development, it promotes employment[3] and it provides continued education for school drop-outs etc..

The participation of employers in the financing is considered important.

A training levy system will be established, which will channel funds from employers to the National Training Fund. The levy system will be based on employers' turn over or on the payroll. The Government will offer deductions in these contributions as incentive in relation to training carried out by employers.

The participation of employers in financing of the VTET system is important, as this stresses industry's interest in, and responsibility towards, the training system and thus strengthens the link between industry and the training system.

The Participation of the Beneficiaries in the Financing of the System is Considered Important

The trainees will be requested to pay a small, token course fee. However if the trainees/parents are unable to pay fees, the Government will offer assistance in the form of revolving training loans or scholarships. In rural programmes, local communities will, where possible, contribute materials and labour for the construction of institutions (self-help). The skills upgrading activities currently carried out will be expanded, and course fees charged, covering all costs and a profit, thus contributing to the financing of the system.

The areas offered as income generating skills upgrading courses will be expanded to semi high-tech areas, such as ABS systems and fuel injection in the car maintenance sector.[4] The equipment needed for these types of training can be financed through the fees charged, but might also be used in the ordinary training activities for non-paying students.

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[3] Especially in the Palestinian case, where Palestinians have to compete with other nationalities about employment in foreign labour markets, notably the Israeli labour market.

[4] Courses could be offered in ABS systems, fuel injection, computer control systems etc..

Income-Generating Activities in Training Institutions Will Be Regarded as Means of Reducing Government Fund Allocations to the VTET Sector.

Income generating activities will be regarded as a source of income that will reduce Government fund allocations to the VTET sector. However, in developing and executing income generating activities, the following guidelines must be observed:

- Income generating activities may never impair the training objective of the VTET institutions and courses taught
- Income generating activities may not impose unfair competition on the local or national industry.
- Income generating activities may not finance more than 50% of any given course, or 20% of the total running costs of any VTET institution[5].

The VTET institutions may trade directly with consumers, or may act as a subcontractor to other suppliers. This in itself will be part of the efforts to direct training towards self-employment.

As a method for decreasing the chance of the production objective impairing the training objective, the VTET centres may separate into a production centre and a training centre, and thus having two different entities: The training entity in which trainees spend the first section of their training period. The training entity should be staffed with trainers and teachers, who have the goal of transmitting all the necessary skills, and where only exercises are executed. The second entity—the production entity, where students spend the second section of their training period, should be staffed by master craftsmen, and have profit as a goal. The trainees here work in a simulated but almost true firm which, besides producing a profit that can contribute to the costs of training, also conveys to trainees; punctuality, quality awareness, the ability to co-operate and to work fast and efficiently.

National and International Grants and Donations

Despite the availability of the four sources of income, it is foreseen that it will be difficult to cover the running expenses of the VTET system, as well as the expenses of expanding and developing the system. The Government thus welcomes all national and international grants and donations. Grants and donations may be earmarked to any training institution, whether private or public as wished by the donor, as long as it is in compliance with the established national priorities[6]. Grants and donations may also be given to the National Training Fund for the general use of the VTET system.

National Training Fund

The Government will establish a National Training Fund (NTF). The NTF will receive all funds collected for the use of the VTET system, and allocate this funding according to the decisions of the Council on Vocational Training and Education.

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[5] These figures are supported by research conducted by Brodersohn in Trinidad, Tobago, The Dominican republic, Panama, Honduras and Cuba. Brodersohn, Mario: Public and Private Financing of Education in Latin America; A Review of its principal sources. In The Financing of Education in Latin America. Washington D.C 1978, Inter-American Development Bank.

[6] The national priorities are established by the VTET council (please see section 3), by this strategy and by the action plan on the implementation of the strategy (please see section 7)

3. The Structure of the New Palestinian VTET System, Interrelations with the Rest of the Educational System and Management of the Revised System

The Present System

At present, there is no unified system for Vocational Training and Vocational Education, as these types of training are carried out in separate types of institutions, run by respectively the Ministry of Education and the Ministry of Labour.

Fragmentation

In fact the vocational education and training system in Palestine is highly fragmented and there are a large number of training providers besides the PNA. The system is small, yet has several sponsors and displays a variety of formats. All in all, there are more than 230 institutions in the West Bank and Gaza providing short and long term training programmes[7]. These include vocational secondary schools, vocational training centres, cultural centres, societies and charitable organisations and agricultural and economic development centres. In addition to that, comes the 23 Community Colleges providing post secondary education.

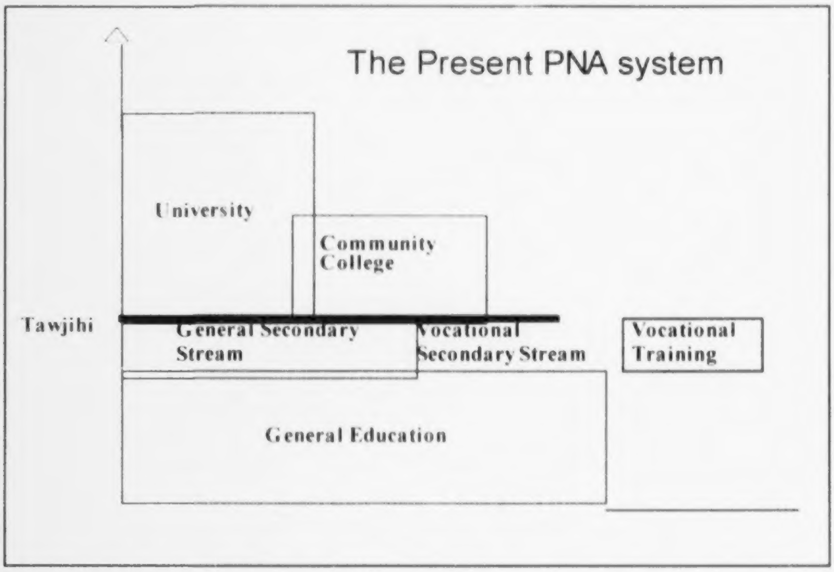

Figure 1: The present PNA educational system

These institutions are run by several bodies: The Ministry of Education, The Ministry of Labour, The Ministry of Welfare and Social Affairs, UNRWA, several international philanthropic associations and a large number of religious and profit organisations.

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[7] Hashweh, M. Towards a national vocational training system in Palestine Jerusalem 1995. pp 7 10.

A person can train to become a carpenter in more than 20 institutions that offer this training. One can become a carpenter in nine months, 11 months or 24 months. A person may train for carpentry in vocational secondary schools, or in a training centre run by UNRWA. The Ministry of Labour, or the Ministry of Welfare and Social Affairs, or quite a number of private institutions and each time using different curricula.

Consequences of Fragmentation[8]

Fragmentation leads to duplication and seriously impairs efficiency, due to the fact that the presence of so many unconnected and uncoordinated training institutions means duplication in development of curricula, methods for training of staff, establishment of administrative systems, and employers' possibilities of having a clear concept of the qualifications of the potential employee is very poor — the system becomes non-transparent. Thus the system becomes inefficient and costly.

Fragmentation also leads to a training policy which is diffuse and uncoordinated. In fact it will not be possible to have a national training policy, as there is no single or even identifiable agency that speaks for training in the economic policy and planning process, co-ordination between industrial and other types of economic policy on one hand, and training on the other hand becomes impossible, or at least very difficult.

Finally, with a fragmented system, employers find it difficult to interact with the training system at a national or regional level.

Vocational Education vs. Vocational Training

The question of whether to separate or integrate the vocational education and the vocational training system is one that has taken many careful considerations in all parts of the world. As seen above there are plenty of reasons for a unified system.

It is in general perceived that there are fundamental differences between vocational education (VE) and vocational training (VT), and especially between the objectives of the two systems. However, the current trend is clearly that VE and VT are converging. This is primarily due to the below mentioned fact that production technology and innovation are developing at an ever increasing speed. This means that the concept of obtaining vocational qualifications at the level of skilled worker, and afterwards not having to be retrained, is becoming increasingly invalid. Instead one has to accept the idea of life-long education, and thus not only unskilled but also skilled workers have to be involved in continuous retraining and, as a result, the differences between VE and VT, and also between skilled and unskilled workers become ever increasingly blurred.

A Unified System

As the differentiation between VE and VT thus becomes still more irrelevant, it seems only reasonable to combine the two systems in the West Bank and Gaza at this point, where the PNA has taken over responsibility for the training institutions and where a major revision of the system thus is under way in all circumstances.

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[8] Based on Skills for Productivity—Vocational Education and Training in Development Countries, John Middleton, Adrian Zidermann, Arvil Van Adams, World Bank, Oxford University Press, 1993.

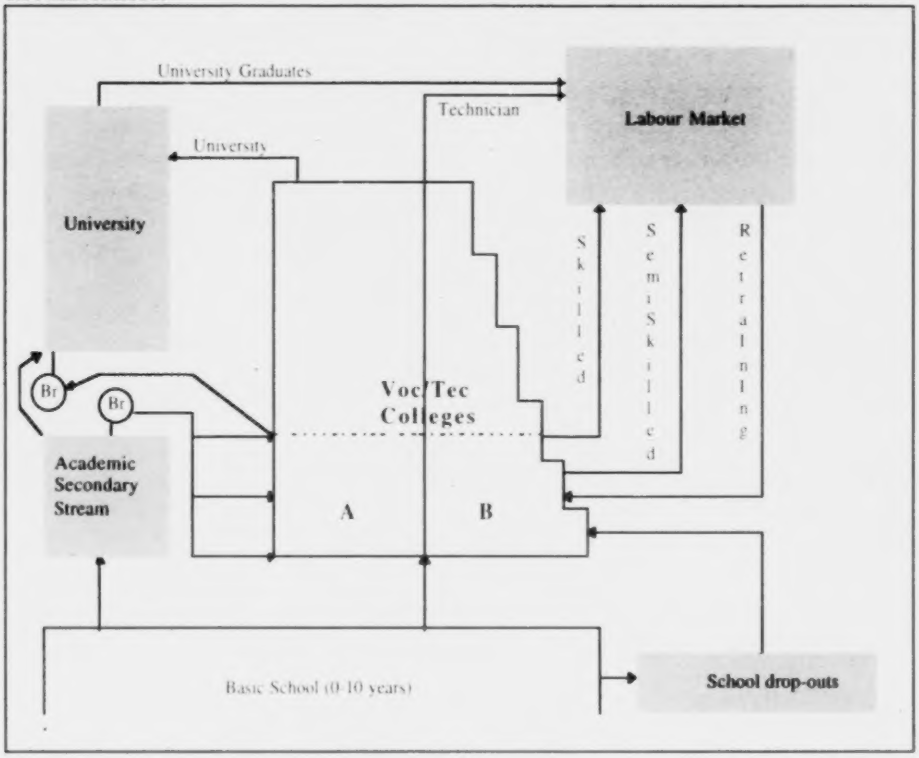

Figure 2: The revised system

A unified system, under the auspices of the PNA will look like Figure 2 and contains a number of characteristics:

The earlier mentioned problem of fragmentation of the present VTET system is removed by unifying the two streams of respectively Vocational Education and Vocational Training, and by creating a strong link between the VET system and the present community colleges, thus making it a real VTET system, comprising all the tasks that are traditionally found in/carried out by respectively Vocational Education, Vocational Training and Technical Education (hence the term VTET-Vocational Technical Education and Training).

Furthermore it is noted that students that wish to obtain further education after obtaining certification as skilled workers (the present VET centres), may directly continue their education to obtain a degree as technicians (the present Community Colleges). Persons holding a degree as technicians will also have the possibility to continue to university, without taking the Tawjihi.

These options for continued studies should however not obstruct the main point of the revised system, namely to produce skilled workers, such as carpenters, plumbers, car mechanics, electricians etc.. Consequently some form of numerical limitation on the possibility of continued studies will be necessary, ensuring that only the very best graduates continue their studies, while the rest join the labour market.

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It is noted that the Voc/Tec Colleges are divided into an A and a B stream. First it has to be realised that the system will be modular (please see below). This allows the system to cater for both retraining/training to the level of semi skilled and for training to skilled worker, utilising one or more of the individual modules for the first purpose and utilising the full range of modules in any given specialisation for the second purpose. This also means that students that join the system and take only one or a limited number of modules after which they join/rejoin the labour market, may come back at a later point in time in order to take the remaining modules in their line of specialisation, after which they will obtain diploma as skilled workers.

Target Groups

The system will, in accordance with the comments made above, be able to provide retraining/training for adults.

The system will be catering for the graduates of the General Education system. Finally the system will be able to cater for school drop-outs, a group which presently counts between 11,000 and 18,000 persons annually.

The system will be able to deliver training at the following levels:

- Semi skilled worker
- Skilled worker
- Technician

Modularisation

The unification of the VE and VT systems will be achieved through a modularisation of the two systems. A modular curriculum furthermore ensures a curriculum that is flexible, and thus can be adapted to the changes that Palestine might face, and a curriculum that can serve initial training as well as upgrading.

Modular training is the combination of different training elements (modules) on the building block principle. Each module provides a qualification in a specific job. The modularisation of vocational training has two aspects: 1) A large number of ways of varying the module combination and thus a wide degree of adaptability to different needs. The individual student can arrange the modules horizontally for obtaining broad basic training, or vertically to obtain a highly specialised qualifications profile. Combining modules which fit together horizontally and vertically results in a profile of qualifications which very much resembles that of high quality long term training. 2) The possibility of standardising small, self contained learning packages, and thus of quick adaptation to industrial and economic change.

Modularisation will thus enable students to participate either in short training programmes (one or two modules) for 2–8 weeks, or longer training by combining a whole series of modules, enabling a student to move from completely unskilled to skilled worker.

In this manner there will be no reason for differentiating between VE and VT, and thus between the vocational institutions of the Ministry of Labour and the vocational institutions of the Ministry of Education, and the curricula, teachers training and other developmental work of the two types of institutions can be unified.

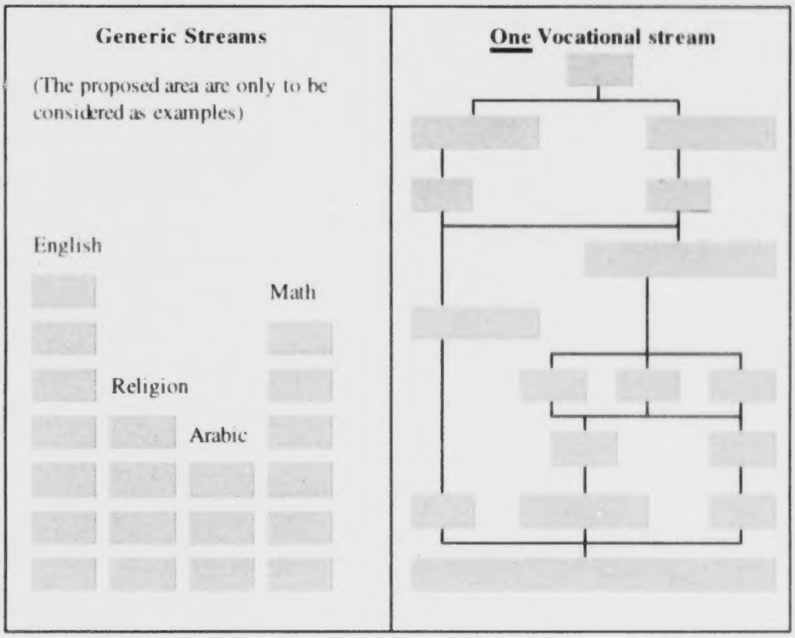


Figure 3: The modular structure

The modularisation will comprise not only the job-specific skills, but also generic skills, allowing students to combine the two, or to only take job-specific modules. Some of the more specialised job-specific modules within certain occupational branches, may also have as a prerequisite one or more of the generic modules. For instance, a module in advanced electronics, may have modules in maths as a prerequisite. The modular structure of the system thus will look like Figure 3.

Management of the Unified System

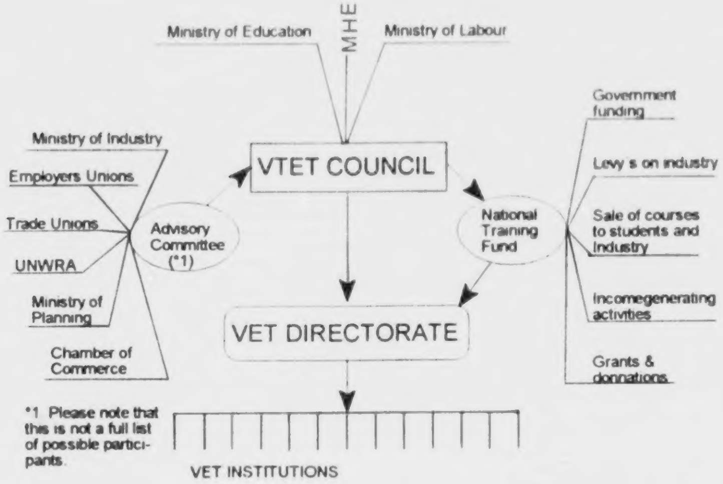
As it is accepted that the new type of institutions will be identical, no matter which system they originally stemmed from, there is no clear answer whether to place the institutions under the Ministry of Labour or the Ministry of Education or the Ministry of Higher Education. Consequently a Council of Vocational Technical Education and Training will be established. The Council members will be experts from the three Ministries and the Ministers of the three Ministries. The Ministers will take turns, one year each, chairing the Council.

Furthermore the Council will be expanded with members from third party ministries, when the Council is discussing questions that affect other ministries, such as training in the tourism sector (Ministry of Tourism) or the training of paramedical (Ministry of Health) or the co-ordination of industrial policy and training policy (Ministry of Industry/Planning).

The Council of VTET will be responsible for managing the new unified centres, at the strategic/policy related level. To execute the policy and strategic decisions of the Council, a Directorate for VTET should be established, which will also be responsible for the day-to-day management and development of the system.

In order to ensure a close link between the VTET system and the rest of society — especially the labour market, an advisory committee on VTET will be established. The membership of the committee is to be decided upon by the VTET council, but could resemble the ones participating in the present advisory council of vocational training. In an initial phase, a development branch may or may not be placed outside but closely linked to the Council. Finally a training fund, providing the funding of the system (the VTET directorate and the centres) will be established. Consequently the system may look as Figure 4

Figure 4: Management of the unified VTET system


Ministry of Education
MHE
Ministry of Labour
VTET COUNCIL
Ministry of Industry
Employers Unions
Trade Unions
UNWRA
Ministry of Planning
Chamber of Commerce
Advisory Committee (*1)
National Training Fund
Government funding
Levy s on industry
Sale of courses to students and industry
Incomegenerating activities
Grants & donnations
VET DIRECTORATE
VET INSTITUTIONS

*1 Please note that this is not a full list of possible participants.

4. Target Groups

It has already been established that the revised and unified VTET system should be catering for: training/retraining of adults, training of graduates from the General Education system, and training of school drop-outs. This does however not address the question of whether all persons wanting should have access to training, and if not so, should certain groups (woman, disadvantaged, ex-political prisoners, school drop-outs etc.) be given priority.

Demand-vs Supply-Driven Training

The basic question that needs to be addressed is whether the system should be demand or supply driven[9].

International experience shows, that:

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[9] In a supply driven system, attention is given to the needs of potential students, in the sense that all persons who want training/education are accepted by the system. Thus no, or very little, attention is paid to the needs of employers. Instead the aim is to provide qualified persons to the labour market, without significant reference to the skill requirements of the labour market. Supply driven training is often associated with centrally planned and publicly provided training. On the other hand, demand driven training takes as its point of departure the needs (skill requirements) of the labour market. Thus close attention is paid to the identification of real employable skills. As a consequence it will often be the social partners who specify what is required, in terms of skills, by the labour market.

- Training does not create jobs
- Trained people holds a competitive advantage over untrained people in competing for jobs
- Skills get rusty if not used
- A pool of trained people may attract investment, which will create jobs.

Thus it is recognised that supply driven training almost certainly will result in giving to many students the wrong (unemployable) skills and thus result in training for unemployment, which not only is wasting students' time, but also an inefficient use of government funding.

An efficient training system is not achieved if trained persons do not use and benefit from their skills. Efficiency in turn is a prerequisite for equity. Economically and socially disadvantaged citizens do not benefit from training unless the skills learned increase their productivity in employment. Demand driven training therefore will form the basis for the PNA VTET system.

Labour Market Monitoring

As a consequence, the training system must establish some form of labour market monitoring, and close co-operation with the employers and trade unions, in order to establish what the skill requirements of the labour market are[10].

In establishing the demands of the labour market, it is realised, that a) training is always for future demands and, accordingly, the system should forecast the future demands and b) the size of local labour markets is often overestimated, in the sense that geographical mobility of employees often is low (and especially so on the West Bank and in Gaza). Thus it is not very relevant to establish a lack of skilled welders in the West Bank in general, if this deficit is placed in Ramallah, as this is only relevant to training institutions in the Ramallah area. So one has to be very careful of the geographical aggregation of data.

Training As a Catalyst

As unemployment is presently very high in both Gaza and the West Bank, the training system will be given a catalyst role, training somewhat more people than what is actually presently required, in a hope that the future will show improving economic conditions, and in a hope that a pool of qualified labour might contribute to the attraction of increasing investment in industry and production. It follows that the overproduction of graduates must be at least partially placed in economic sectors, that are pinpointed by the PNA as strategic areas of development.

Furthermore the slight overproduction of students is also decided upon, as Palestine has a historic tradition for exporting labour to neighbouring labour markets, and as trained people hold a competitive advantage over untrained people in competing for jobs, the training received may help the graduates in their competition for jobs in foreign markets.

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[10] If it is accepted that the training system should primarily cater for the needs of the Palestinian labour market, but that it should also train for other markets (e.g. the Israeli and Arab labour markets), it might also be considered, to take into account the opinion of the employers and trade unions of these labour markets, in order to assure the employment of as many Palestinians as possible, since it seems obvious, that the Palestinian labour market can't absorb the entire Palestinian labour force at the moment.

A final reason for the mentioned slight overproduction is social reasons, as it will give students an opportunity to improve their employability, if not give a guarantee of a job subsequent to the reception of training. However it is realised, that, with the acceptance of such an overproduction, the training system has entered a route that contains the dangers of the supply driven training system, and thus the amount of students will have to be constantly and closely monitored.

Marginalised Groups

Having chosen the route of a demand driven system, albeit with a slight overproduction, this does not preclude some form of quotas for marginalised groups, such as women, handicapped, ex-political prisoners, school drop-outs. For social reasons some preference will be given to these and other relevant disadvantaged groups.

Guidance and Counselling

Finally a comprehensive system of guidance and counselling must be established, assisting potential students in choosing occupations that suit their abilities and preferences, but also match the demands of the labour market system, thus increasing the chance of employment after graduation.

5. Training of Nationals to Work Outside Palestine

It is realised that, for obvious strategic and economic reasons, it is preferable if all Palestinians can be employed in the national labour market. However, looking strictly at the available labour market statistics of the West Bank and Gaza, the high unemployment rates and the low participation in the labour force[11] seem to indicate that in the short and medium term, there is not much choice but to include both the Israeli and the Arab labour market as potential places of employment for Palestinians, enabling these persons to contribute to the wealth of the nation.

In the long term, it is envisaged that the Palestinian economy/industry will be sufficiently strong to absorb the entire Palestinian labour force, and the Government is dedicated to support a development of the Palestinian economy, which will achieve this. Having accepted that the Palestinian VTET system should also train for outside markets, two points have to be made: It must be avoided, that the needs of the Palestinian labour market gets crowded out, by those of the neighbouring labour markets, due to higher pay or any other reason. This danger should be avoided by supplying sufficient amounts of qualified labour. Furthermore, history has shown that a too heavy dependency on the Israeli labour market may be dangerous, as closures unilaterally imposed by the Israeli government will substantially hurt the Palestinian economy.

As it is accepted that the Palestinian VTET system should also train for outside labour markets and, as it is accepted that the VTET system should be demand driven, it follows logically, that the monitoring of the labour market needs for skills should include the needs of the outside labour markets.

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[11] According to figures in "Meeting the Challenge", the Expert Team, section III.2, only 55% of adults (above the age of 15) participate in the labour force, discounting the old and ill. This figure is very low, compared to, e.g., Denmark where the participation rate is more than 80 %.

6. The Roles of Government, Local Community-Based Organisations, Foreign NGOs, the Private Sector and UNRWA in Providing Training

The PNA recognises the role of NGOs, UNRWA and others in providing training to the Palestinian people during the past decades. The PNA recognises the value of the training provided, and the expertise gained by these institutions during the past years, and welcomes a close co-operation with the mentioned institutions in order to utilise the mentioned experiences, in the development of a national VTET system.

Already at this stage, it is clear that the capacity of the revised training system will have to be increased vastly, and as resources are scarce, it only makes sense to encourage all other training providers to continue offering vocational education and training. However, it is important that all training provided leads to qualifications that are recognised nationally, in order to ensure a transparent training system. This means that the Government should involve all training providers in developing curricula and testing and validation measures. Once these are developed, all training providers will be offered the use of the curricula and admission to the national testing system.

The involvement of the other providers in the development process means that this process will benefit from all resources available not only those of the government. This is particularly important in the case of UNRWA which has benefited from extensive external support ever since the establishment of its centres.

7. Implementation

It is acknowledged that the system described in this strategy is very ambitious, and that it will take large amounts of resources, both in the form of time and money, to implement. It will be a prerequisite for a successful implementation of the strategy that the implementation is executed in an orderly and well planned manner to avoid the possibility that duplication, confusion, lack of funding, etc. impair the process.

The PNA realises that it does not hold the financial means required for implementation, and calls on the international donor community for assistance.

To ensure that all internal, external, national and international contributions to the implementation is utilised efficiently, an action plan on the implementation will be drawn up immediately after the adoption of the strategy. The action plan will outline the different elements in the implementation and their interconnection with each other. The action plan will prioritise the different activities and determine the order in which they are to be dealt with.

30

Reference Paper on the National Palestinian Vocational Technical Education and Training Strategy

Ministry of Higher Education, The Palestinian Authority

1. Introduction

The Palestinian Vocational Technical Education and Training Strategy (VTET) has been adopted. The strategy is a political statement, which describes the vision of the future Palestinian VTET system and outlines the characteristics and features of the system.

The main characteristics of the VTET system as outlined in the strategy are:
- A unified national vocational education and training system
- Demand driven, albeit producing a small excess pool of skilled labour
- Based on labour market monitoring
- Participatory; involving all concerned, especially the social partners
- Emphasis on practical learning rather than "talk and chalk" lectures
- Students with the wish, the ability and who fulfil the requirements may continue to Community College or University after graduation.

The target groups of the VTET system are:
- Graduates of the Compulsory General Education system
- Drop-outs from the General Education system
- Adults in employment (training and/or retraining)
- Adults in unemployment (training and/or retraining)
- The training provided will aim primarily at the Palestinian labour market, but also at neighbouring labour markets.
- The system will be modular
- The system will provide primarily job specific modules, but also generic modules

The financing of the system will be based on:
- Government financing
- Levy/tax on employers
- Payments from students
- Income generating activities
- Grants and donations from national and international sources.

The paper on the strategy is a self-contained unit, that can be read by itself in a meaningful manner. However, as a number of questions have been raised concerning some of the technical details of the strategy, it has been decided to draft this reference paper, which aims itself at the specialists that are going to work with the strategy and implement it. The decision to place these more technical details in a separate paper, rather than incorporate them into the strategy, is based on the wish to keep the strategy as a political vision statement, rather than a difficult technical document, which only will attract the attention of the skilled few.

The reference paper does not pretend to be meaningful by itself, but on the contrary only makes sense if it is read in conjunction with the strategy itself.

The third and final paper that will be drafted in accordance with the strategy (besides the strategy and the reference paper) will be the action plan, which will describe, in detail, the steps foreseen in the implementation of the strategy.

The reference paper will deal with structural questions, during the transitory and final stages of the development envisaged, the formal and informal components of the training system and finally the main paths through the modular structure towards qualification as skilled worker/technician.

Furthermore this paper will expand on the concepts of modularisation, inter-linkage with the labour market (labour market monitoring), the political decisions required in order to ensure the implementation of the strategy, the main changes to the present system, and finally the transition planning aspects will be outlined.

2. Modularisation

2.1 Introduction:

The main objective of vocational training is to provide people with the skills required to perform, under prevailing conditions and to established standards, all tasks related to a given job, occupation or to self employment. Traditional vocational training programmes are designed to provide trainees with such skills within the framework of comprehensive, long-term and time-based training programmes, where fixed learning groups are to pass along well-defined curricular paths. This model is easily planned and, if executed competently, gives a high degree of efficiency, albeit with a lower degree of validity or external efficiency, as it is not sufficiently flexible to adapt to changes in labour market demands, especially in areas related to fast evolving technologies.

To compensate for that, it has become internationally acknowledged that modularisation of instruction is the preferred way to adapt an educational system to the needs of the society as well as to the changes in technology or client demand, thus ensuring a high degree of validity of the educational system. Modularisation is not a goal in itself. It is a mechanism to achieve the objectives set down in the strategy.

The shift from traditional time-based training programmes to modular training programmes involves major changes on many levels. The most important however, are the changes in assessment concepts and methodology. Modularised instruction is competency-based instruction. i.e. assessment of trainee is done against a clearly defined task that he has to perform under certain conditions and up to a certain standard, regardless of the time spent in training.

The second major shift is related to how a certain curricula content is divided into certain units or divisions. Breaking up of curricula has always been done by instructors mainly based on subject considerations. However, in modularised instruction, breaking up of curricula content is done differently, where each unit is self-contained. 'i.e. each unit is independent and contains all the theoretical knowledge, practical skills and attitudes required to achieve the skill targeted by the unit. This method of breaking up curricula content allows for each unit to be used in different contexts and to be changed, modified or deleted without having to change the whole curricula.

2.2 Modularisation

As mentioned above, modularisation implies the subdivision of the total required qualifications for a given occupational profile into a set of employable competencies or skills, each of which then has to be delivered by one module. The subdivision of a given occupation into competencies cannot be done in a similar fashion in any two countries. It has to take into consideration the national/regional, cultural and technological factors of particularity.

In a purely standard curricular approach, the required set of modules are in a rigid sequence, while in modular approach it is up to the individual to chose the sequence and sometimes the amount of modules he or she will take. All existing educational systems are a mixture of these two extremes, for example obligatory courses or elective courses in fixed study plan can be considered modules.

The typical size of modules can be approximated as follows: One full occupational qualification range may contain 20 to 40 competencies, for two years of full training this corresponds to about 3–4 weeks per module. The identification of the modules will be done by local expert groups for this occupation.

2.3 Modules

When the definition of a module is examined on an international basis, it has to be realised that the definitions applied are to some extent different. There exists no standard description, although there is a number of common denominators. The approach to modularisation clarified above implies the following definition of a module: *An instruction unit conceived to deliver an employable skill.*

A module then has the characteristics: self-containment as far as possible, with defined entry and exit qualifications. Its contents are:

- Teaching/learning subject
- Instruction/learning methods
- Teaching/learning objectives (if possible, in operationalised form)
- Required equipment
- Assessment method.

2.4 Limitations of modularisation

2.4.1 Subject limitations

Modules that are absolutely independent or self-contained cannot be achieved over the entire spectrum of subjects. Some subjects have a very strong internal sequence that cannot be violated. Such subjects can be divided into modules, but these modules cannot be taken out of sequence, and most of them will carry a strong prerequisites statement, the whole set of modules for the occupation can usually be arranged in a multi-linear order. Examples of subjects with a strong internal sequence are : digital electronics, languages and accounting.

2.4.2 Institutional limitations

In order to obtain the necessary flexibility in the implementation of the modularisation, the following will be required:

- A minimum size of the teaching institutions, so that equipment and facilities are not left idle and parallel modules or groups can be executed.
- Corresponding continuous demand for the range of the modules offered, which requires a careful analysis of the demand for skills in the labour market as well as continuous co-ordination with employers as to the specific range of modules to be offered.
- The administrative capacity to manage formal plus informal participants.
- A full range of equipment for each occupation offered (this, however, is true for any system, modular or not).

2.5 Proposed modularisation application range

The application of the modular approach might start with non-sequentially structured subjects, such as clerical, social and non-technical subjects and then be extended to sequentially-ordered occupations such as technical and language subjects.

The change from time-based to competency based training is not an easy one, as competency based training puts even higher loads on the administration and the teachers of the educational system. However if the appropriate preconditions are met (mainly teacher training/experience, organisational flexibility), the modularisation could gradually be developed into being competency based.

As general subjects and vocational modules cannot be taken together, the main paths, at least initially, cannot incorporate vocational modules plus general subjects. This does not rule out that somebody selects an individual path with mixed general subjects and vocational modules.

The standard training progress assumes full-time attendance. This poses no problem for participants in the formal system. The system administration must also provide for part-time attendance to allow for outside work and training simultaneously. This can be done with extended instruction hours, which of course requires additional effort and manpower, but also yields a corresponding increase in out-put and an increase in the utilisation rate of equipment and buildings.

2.6 VTET level considerations

The qualification processes on the two levels can roughly be characterised as follows:

VTET Level 1: high degree of manual skills - less theoretical or conceptual knowledge

VTET Level 2: emphasis on subject interrelations and conceptual knowledge, limit on self-containment of modules.

Hence the introduction of the modularisation is more suited to Level 1, and should consequently start there. After acquiring sufficient experience in development, implementation, teacher training and certification, the extension to Level 2 may be carried out.

2.7 Development process

The development process contains the following steps:

1. Development of a standard work plan and standard module description.

2. For each occupational field, a development group will be formed with personnel from teaching institutions, administration, curricular experts and society representatives.
3. A limited number of recognised occupations will be defined and occupational profiles will be specified stating the required competencies/skills (20 to 40).
4. These sets of competencies will be divided into single employable skills and corresponding modules will be developed.
5. The sets of modules will be arranged, if applicable, into standard sequences. Restrictions and limitations will be clearly specified.
6. The criteria for module changes will be defined and maximum validity periods given.

2.8 Implementation process

The necessary changes in administration, teacher training, etc., are too large to allow for a immediate full-scale introduction of the modularisation into VTET. It will start in occupational fields where modularisation comes naturally: economics, social subjects (Level 1) and will be extended gradually to the other fields and to Level 2. Hence there will be a period of parallel modular/non-modular instruction in all institutions. This requires higher system input but cannot be avoided.

As new modules are developed, they will be incorporated into the existing structure. This may lead to using temporarily a module as a teaching unit in a curricular path. After the development of all the modules for a path, it will then be fully converted to modular form. The change-over period requires careful counselling and cautious planning to avoid individual and institutional setbacks.

The introduction of modularisation may take place when

- The teaching facilities correspond to the requirements set down in the modules,
- A sufficient number of modules for one occupation has been developed,
- The teachers concerned have been trained in the teaching methodology and assessment techniques,
- The administration has been trained to handle the higher planning and management demands of the new system.

This reflects the underlying need of preparation in the fields of physical, human, and organisational resources, which can be developed only at a limited pace and whose funding is undefined at present.

2.9 Conclusions:

Modularisation, which entails a relaxation or removal of curricular restrictions to allow for higher flexibility of the educational system, leads to a higher diversity in the system utilisation, which usually requires an increased overhead for system management and administration.

Hence, the gains due to modularisation can only be achieved through a relatively higher input of system resources. Any adjustment of the system to societal or individual needs requires monitoring of the needs, changes in management, changes in module content, changes in teaching equipment and additional certification. These costs have to be taken into account and should be included in the overall cost estimations. The total effect will be a higher degree of (external) validity of this system and, probably, a limited decrease in (internal) efficiency. A well-considered approach to modularisation is nearly certain to produce a net gain to society through the avoidance of unnecessary skill-production and the gains in system adaptability.

Although there is ample international experience with the modular system, at present there are no full-scale applications of modular teaching in Palestine, as only limited experience can be gained from a sectional approach by UNRWA.
This leads to the conclusion that:

- Modularisation should first be introduced to the Palestine VTET in those areas where the advantages are obvious,
- An initial phase (probably of several years) will be used to obtain validation of the approach.
- The extension of modularisation to a full-scale approach requires an appropriate decision at a later time.

The following table lists the main expected effects of modularisation on the VTET system in different areas of flexibility, which is the basic rationale for this system approach:

Area	Gains	Costs
Time	Freedom of choice of different instruction times and sequences Possibility of non-formal training (retraining)	Extra administrative costs, due to capacity variations
Volume	Choice of different instruction volumes; non-formal training, upgrading	As above
Speed	Completion according to individual learning abilities; individual qualification	As above + higher teacher qualification necessary
Access	Higher number of entry/exit points, non-formal training	Higher administrative input
Curricular	More flexibility, through easier change of contents and methods	Teachers training necessary, modular curricula more time-consuming to develop
Adaptation	Possibility of adaptation to regional/-local needs	Labour market monitoring and other types of data acquisition

3. Structure

3.1 Main Premises

The strategy advocates a system with the following characteristics concerning structure:

- The main purpose of the first level of the VTET system is to produce skilled workers.
- The main purpose of the second level of the VTET system (the present community colleges) is to produce technicians, craftsmen, and managers.
- The skilled workers may continue with their education and training to the second level of the VTET to train for the level of technicians without any barriers.
- It is not the aim of the first level of the VTET to produce graduates to join universities, as this is the job of the general academic secondary schools.

However, graduates of the first level of the VTET may continue to universities if they wish to do so, but this has to be on their own time and with their own efforts in order to meet the requirements of entry at the universities which is currently the Tawjihi examination.

- Adults may upgrade their knowledge and skills at both levels of the VTET, being restricted only by entrance requirements of the specific modules.
- Drop-outs from the general education system may join the formal system only after having accomplished bridging courses offered by the general education system enabling them to reach the level of compulsory education graduates. However, as in the case of adults, they may without any prior conditions other than those embedded in the individual module, join a single or a group of modules, which will give them the certification for the modules taken, but will not entitle them to an occupational degree.

3.2 Justifications:

There are many reasons for drafting the proposed VTET strategy, one of the main reasons is to amend the distortion in the formal education system where most students are streamed into universities and end up unemployed on one hand, while properly qualified skilled workers are quite hard to find. 60-80% of the young people leaving the twelfth grade enter university, while approximately 3% enter VET. Six months after graduation approximately 75% of university graduates are still unemployed, while 65-75% of the VET graduates are in employment.

Consequently, it is not the intention of the strategy to find another way to join university. Persons with academic inclinations choosing to go to universities should mainly do so by joining the academic stream and sitting for the Tawjihi.

A further reason for not trying to produce graduates with dual obligatory qualifications is that this will necessitate an extension of the training time, which will only be of direct benefit to a very small minority, namely, those who enter vocational training with the aim of continuing to university.

International experience shows that about 2000–2400 contact hours, equalling about two years of training, are required in order to train a skilled worker. Consequently, it is not possible to produce a person that is a qualified worker on one hand, and an equal to an academic secondary stream graduate, as far as academic knowledge is concerned, in two years.

Therefore it will only be possible to create graduates with dual qualifications if the duration of training is extended to at least three years. However, in order to ensure as high a flexibility as possible, the VTET system will offer generic, non obligatory modular (evening) courses for those VTET students who wish to sit for the Tawjihi in some of its larger institutions. This will enable the first level VTET students to become doubly qualified, and thus have the freedom to choose whether they want to join the working life or continue on with their university education. Although taking all of the generic modules is voluntary, some of them might be listed as prerequisites for some of the more advanced vocational modules. For instance a basic generic module in physics might be a prerequisite for an advanced electronics module.

Another possible route for VTET level 1 graduates to join university would be to do so through the second level of the VTET. Choosing this solution most probably would mean that only those who are 100 percent sure that university is what they want, are the ones who continue on with their education, which would mean a much more efficient way of utilising time and resources.

In the debate preceding the drafting of this paper, a two-tiered VET system has been advocated; one that prepares for the labour market, and another preparing for the universities.

However, the demand for the economical use of public resources necessitates a unified system. The strategy aims at meeting the challenges with the current foreseen resources available. This does not in any way negate the emergence of other systems or subsystems in the future. Currently, we simply cannot develop curricula for two systems, we cannot but make the best utilisation of the existing facilities and staff.

Furthermore if an "academic vocational secondary education" tier aiming its graduates at university education was to be developed, it would seem more appropriate to develop this as a stream in the present academic secondary education rather than in the VET system; practical vocational training does not (and should not) prepare students for academic education, and if the "academic vocational secondary education" is not to be based on practical vocational training, but on more theoretical academic education, then it belongs in the academic secondary stream.

3.3 Structure Description:

The following table summarises the main levels of the new VTET system, the numbers quoted are the estimated numbers five years after the start of the development of the system:

Table 1: Main levels of the proposed VTET system

Level	**Objective**	**Quantitative Input**	**Quantitative Output**	**Process**
VTET 1	To transform the qualification spectrum of trainees to produce ***skilled workers*** in areas of demand by the labour market	• Around 35% of the graduates of 10th grade, with a total population of around 35,000 graduates	About 20%–30% of total entries to labour market, i.e. 6,000–9,000 graduates annually	2,000–2,400 hr. 60%–80% in workshop 20%–40% in classroom
	To upgrade the skills of workers in industry and to produce semi-skilled workers	• Less than 1% of the total labour force with a total population of over half a million persons	About 3,500 persons	Various modules as required individually
VTET 2	To transform the qualification spectrum of trainees to produce ***technicians**** in areas demanded by the labour market	• 10% of the graduates of high school with a total population of around 17,000 graduates • 10% of the output of VTET 1 (Skilled Workers). Total Population of 11,000 students	About 16% of total entries to labour market, i.e. 3,000	2,000–2,400 hr. Ratio of theory & practice & Lab dependent on profession
	To upgrade the skills of workers in industry and to produce semi-skilled workers	• Less than 1% of the total labour force with a total population of over half a million persons	About 3,000 persons	Various modules as required individually

***technicians** as generic term for two years of post secondary education

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Thus the ***main formal paths*** of the formal VTET system are:

- From Basic Education through VTET1 to produce a skilled worker
- From a VTET1 level of skilled worker through VTET2 to produce a technician / craftsman / manager
- From a General Secondary School through VTET2 to produce a technician / craftsman / manager.

Figure (1) presents these main formal paths, showing the estimated approximate targeted number of students in each path.

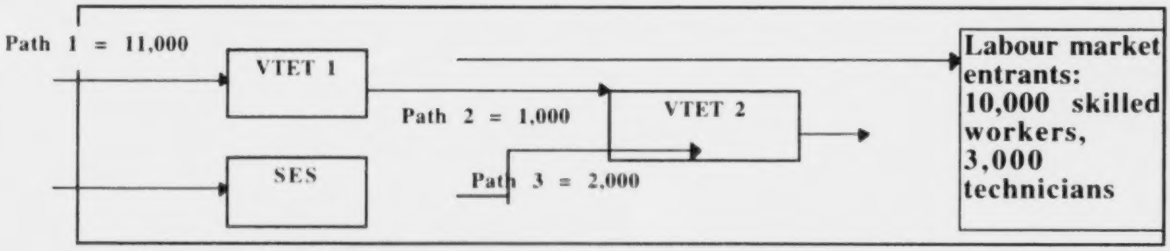
Path 1 = 11,000
VTET 1
Path 2 = 1,000
VTET 2
SES
Path 3 = 2,000
Labour market entrants: 10,000 skilled workers, 3,000 technicians

Figure 1: Formal VTET Paths

Besides the 13,000 students going through the formal path, an estimated other 6,500 adults will train annually at the two levels of the system, thus making the total annual capacity of the system around 20,000 students.

Figure 2 shows the different levels of the new proposed VTET system and its interaction with rest of the general education system in Palestine.

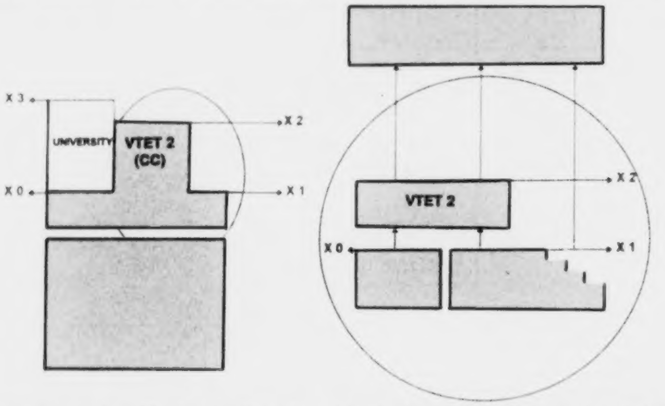

Figure 2: The proposed unified vocational and technical education and training system

In relationship with the above figure, Table 2 shows the main related levels of the education and training as advocated by the proposed strategy.

Figures 1,2 and the following table show the following:

The main input of VTET 1 is a basic education (10 years) graduate.

Dropping out of school, although currently quite common, is not expected to be so in a steady economic, social, and political situation. However at present, it has to be admitted that there is, and has been during the past years, quite a number of school drop-outs, a group that is very vulnerable and has to be catered for. Thus at least for the first five years, the general education system should try to assist drop-outs by either providing directly special modules to assist them rejoin the normal VTET stream or by commissioning specialised private and public institutions to do this job.

Table 2: Qualitative Inputs and Outputs of the various VTET levels

Level	Qualitative Input	Qualitative Output	Duration
VTET 1	Unspecified Educational Background	Semi-Skilled / Upgraded	Variable
	Basic Education (10 years)	X1 = Skilled Worker	2 years
VTET 2	Unspecified Educational Background	Semi-Skilled / Upgraded	Variable
	X0 = High School Graduate	X2 = Technician	2 years
	X1 = Skilled Worker	X2 = Technician	2 years[*]
University	X0 = High School Graduate	X3 = Specialist	4 years
	X1' = Skilled Worker with Tawjihi		
	X2 = Technician		

The main output of VTET 1 is X1 = Skilled Workers in compliance with the demands of the labour market. These are people that are prepared to join the labour market.

The main inputs for the VTET 2 are: X = Secondary School Graduate and X1 = Skilled Worker who is a graduate of VTET 1.

It is noticed that VTET 2 has two main inputs, one having a lot of practical experience, while the other having a lot of academic and theoretical knowledge. Dependent on the profession at hand, several specialisations offered will give an advantage for those with X1 qualification such as the agricultural and many of the industrial and tourist specialisations, while others will give an advantage for those with X qualification such as the commercial and nursing specialisations.

Consequently, in most specialisations it might be necessary initially to separate the two types of entrants, in order to address the different deficits and advantages in knowledge that they hold and to upgrade their respective deficits in knowledge. After the initial separation, where the X1 graduates have their academic knowledge upgraded, and the X graduates have their practical skills upgraded, the two streams will merge, and for the remainder of the training they will follow identical teaching, and they will end up passing the same final exam, and consequently holding the same certificates. However some specialisations might treat X1 and X as equals. This partial separation is illustrated by the vertical dotted line in Figure 2.

Since a demand driven system is advocated, then the actual balancing between the demands stemming from the two main inputs can be regulated. This means that major investments can be done in VTET1 level without hesitation, while one has to be a little bit more careful in the VTET2 level till the right balance of demand is properly recognised.

The main output of the VTET 2 is X2 = Technician (or equivalent) who most probably will enter the labour market. However, those wishing to continue their education at the University level will be able to do (in their own specialisation) regardless of whether they have entered VTET level 2 from VTET 1 or from university regardless of whether they hold the Tawjihi or not. The Ministry of Higher Education will work on ensuring this, involving the universities in the design of the VTET level 2 programmes.

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[*] 2 years is an average estimate of the required duration. The actual duration of a given specialisation might be longer or shorter, but this can not be determined until the actual curricula are developed.

3.4 Certification:

Two levels of formal certificates are to be awarded:

1. Skilled Worker Certificate awarded at level 1 of VTET
2. Technician Certificate awarded at level 2 of VTET

Besides that, certificates of single module completion are granted as part of the further training and upgrading programmes for adults.

The basic question here is whether a cumulative certification procedure will be followed or a final achievement testing or both, the main debate being that a final achievement testing allows to evaluate whether a person has managed to build up knowledge and skills in a constructive and cumulative manner. This is of great importance to give more weight to the degree, particularly if one takes a long period to pass through the occupational training path.

Consequently, in order to prove the high calibre of training, particularly in the initial phase, final testing and national certification have to be conducted, so as to boost the recognition of the training provided, and in order to improve the transparency of the qualifications provided. During the piloting stage, the curricula committees can design the final testing. In the final status situation, an accreditation and validation body will be set up.

3.5 Structure Transformation

The VTET structure will transform in time from a structure with large non-formal component to one with a larger formal component, mainly as the number of drop-outs diminishes.

Formal Training is nationally and publicly accredited and controlled training. It has defined entry and exit points (academic prerequisites, defined learning paths), and leads to an acknowledged degree or limited number of degrees (certificate or diploma) that are based on a clear qualification profile stemming from job analysis. In the formal training, curricula are co-ordinated and sequentially structured, and it is characterised by conferment of authorisation (e.g. for careers in the public service). The formal training paths of the VTET system will be either skilled worker qualification in level 1 of VTET or technician qualification in level 2 of VTET.

Non-formal Training is training that does not lead to an occupational degree. There are no well-defined entry and exit points, and thus access to this non-formal training is only limited by volume and administrative factors. The non-formal training in our case is that of learning one or more individual modules, especially aimed at adults and to a lesser degree school drop-outs. Other non-formal education to be offered by the general academic education system is that of bridging VTET1 graduates to obtain the Tawjihi and thus qualify for university education, and that of bridging drop-outs to join VTET1 entrance requirements (compulsory education).

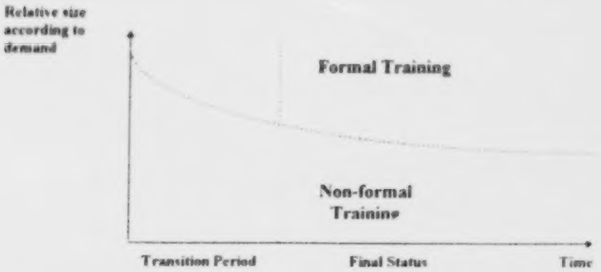

Figure 3: The VTET System Components during Transition

As seen from Figure 3, the non-formal training component is expected to be quite high during the transition period, but will dwindle the more time passes and we approach the final status situation. It is not normal to have 18,000 drop-outs per year. It is also not normal to have a high percentage of the workers in industry unskilled or semi-skilled.

The relative size of the non-formal component of the training system will alter and diminish as the quality of the general education system improves and as the level of unemployment decreases and as the level of skill of the labour force is improved. There will be only one set of VTET institutions handling both formal and non-formal training.

3.6 Conclusions:

The structure is not an aim in itself, but a tool to achieve the best efficiency, effectiveness, relevance, equity, and sustainability. The structure should be flexible and adaptable. It is a dynamic entity that has to develop continuously in compliance with its surroundings. Despite that, the structure has to be well defined and clear. Its entry and exit points have to be well defined, and its interaction with the rest of the system be well clarified. As everything else, the proposed structure is a result of political and social compromise. Its pros way precede its cons.

4 Labour Market Monitoring

4.1 Basic concept

Justification:

In the case of Palestine, where the economy is distorted, unemployment is high and the public resources available are very limited, any investment in the training system can only be justified if it contributes to the overall economic development of the country. This can only be achieved if the largest possible portion of trained people manage to find employment. Thus training has to be closely matched with employment. How best to accomplish this matching remains to be the main question.

Limitations:

It is almost impossible to forecast the changes in the demand for skills in an accurate manner. The economy is a highly dynamic system in which changes are far from being predictable. The experiences of many countries who have attempted to plan their manpower needs based on linear extrapolation of past trends of technological and economic changes have proved to be a failure.

In trying to match the output of the training system with the continuously changing needs of the economy one has to live with the uncertainties involved. It is increasingly becoming evident that it is only possible to forecast changes over a short period of time and with a considerable degree of uncertainty. The need for a highly flexible training system to be able to deal with this uncertainty thus arises. The need also arises for a labour market monitoring system to work on continuously adjusting the output of the training system in quantity and in quality.

In the case of Palestine, there is a need totally to rebuild the training system in order to respond to the current and future demand for training. It is therefore necessary to derive the start-up parameters for this system. These include answers to questions like how many training opportunities should the proposed system provide, distributed over which occupational families and over which geographical areas?

4.2 Deriving start-up parameters for the training system:

Information / Decisions required :

The determination of the start-up parameters of the proposed training system requires the following set of decisions:

- A political decision on the required size of the training system and the relative balance between its formal and non-formal components.
- A political decision on the output exceeding local demand envisaged in the strategy paper. e.g. small excess of skilled labour in certain sectors and training for labour export.

It also requires making available the following information:

- The overall required capacity of the system based on the demand in the labour market
- The main occupational groups which the system will provide training for and the relative size of each group within the training system
- The required regional capacities and the range of occupations in each region.

Data acquisition:

An ad-hoc survey is currently being conducted by the Expert Team to obtain information about the demand on skills in the labour market. The survey is designed to give preliminary information which will be tuned up later on using several methods. The survey is conducted on about 50 types of economic activities in the West Bank and Gaza. These 50 types employ 85% of the total labour force working in Palestine (excluding agriculture). An estimated total of about 800 establishments will be surveyed.

The basic objectives of this survey are as follows:

- Identify the main occupational groups in the local labour market, their relative sizes and distribution on the different types of economic activities as well as the variation on regional basis.
- Getting a feeling for the demand for skills as identified by employers both currently and in the coming 3 years

To facilitate this survey, the current status of the training system is used as basis for deriving a classification of occupational groups. This classification divides training subjects into main occupational groups that are made distinct in terms of economic sectors. A number of occupations is suggested within each group. The grouping of these occupations is mainly based on the assumption that all of them can be trained for using a basic core of facilities, workshop equipment and supplies and that the variations in equipment and supplies required to achieve the specialisation are minor. The classification mainly focuses on training subjects on the levels of skilled workers and technicians, as indicated below.

A correlation matrix will be drawn as a result of the survey establishing the relationship between the different types of economic activity of the establishment and the different occupations, this matrix will show the relative size of each occupation of the total working force in any economic activity:

The results of this survey, although "quick and dirty", if coupled with the political decisions listed above, will form a base for capacity planning of the new system. Several procedures will be adopted in the coming three years and simultaneously with the actual development of the proposed training system, to validate this survey as well as fine-tune its results.

Among these procedures would be a repetition of the same survey next year probably with a larger sample and a modified approach, validation of the results through interaction with the social partners and finally conducting sectoral or regional surveys and other types of surveys as required.

Once the start-up parameters are identified, and as soon as the proposed system has produced its first outputs, long term control and monitoring systems will be utilised to adjust the parameters of the system according to demand.

4.3 Long term labour market monitoring system:

Basic Concepts:

In designing a long term monitoring system it is essential to take into consideration the inherent limitation of labour market monitoring and to accept in advance that this is not an exact science and that a high degree of uncertainty will always exist.

Considering the above, the long term monitoring system will be based on the following principles:

- The indicators that will be used to assess training needs should be kept to the most reliable and the most easy to obtain, no unnecessary data shall be collected.
- An institutionalised relationship with the social partners (employers and employees representatives) is essential both in acquiring intrinsic information about the demand for skills and to validate the acquired data at all times. *The social partners could play the major role in a permanent labour market monitoring system.* One possible form of this institutionalisation would be advisory boards on the sectoral level as well as on the regional level.
- The labour market monitoring system should be structured with a regional focus.

Main channels of interaction between VTET system and society:

The long term labour market monitoring system should be able to acquire data that characterises all channels of interaction between the training system and the society. These channels are identified by the following diagram:

Four main channels of interaction between the VTET system and the society should be targeted by the long term monitoring and control system. These are:

1) **Input to the training system**: this channel can be characterised by several indicators including the population figures, the attitude of general education graduates towards vocational training, their preferences regarding the different occupations and the quality of general education, and the number of applicants to different training courses and institutions.

2) **Demand for skills in the labour market**: This is obviously the most crucial element to be considered in a demand driven system. Information about the changes in the demand for skills can be obtained through several indicators listed below:

- Feedback from employers on perception of future demands for skills, and quality of training provided.
- Earnings, hours of work, spells of unemployment, employment rates of the graduates of VTET system.
- Changes in absolute and relative unemployment rates.
- Numbers. of job vacancies.
- Changes in the relative wages between different occupations.
- Relative wages for occupations requiring the same amount (length) of training.
- Job advertisements in newspapers and other relevant media.
- The introduction of new industries and production techniques.
- Slow-down in previous employment growth.

3) **Political decisions**: Those are very important in determining the relative significance or importance to be given to all the other factors. In general, these decisions determine the balance between the responses that the system shows to the different influences it is subjected to. This is particularly important to materialise the notion that the system is not absolutely demand driven. It is a system that is demand driven but also takes into consideration the strategic interests and objectives the society. A list of expected necessary political decision can be found in part 5 of this paper.

4) **Output of VTET system**: The system's performance is also a key variable in the dynamic equilibrium described above. The system's capacity and the number of graduates it produces also should be monitored since they affect the balance in the labour market.

Methods of data acquisition:

When designing the long term monitoring system, several methodologies are available to collect data characterising each of the interaction channels described above. However, the number of indicators to use, how to collect data and how to best deduce reliable results would be a decision to be taken by the party which will create and administer the monitoring system taking into consideration the above principles as well as the available resources. It is also important to consider the possibilities of using the channel of the PCBS as a standard channel for data acquisition. Following is a list of the possible method to obtain data on the indicators listed above:

1. Social partners contribution:

This is the most important methodology of obtaining data on the demand for skills in the local labour market. The training system should investigate through its institutionalised relationship with the social partners the possibility of them providing the required data. This will be one of the most efficient and credible methods of obtaining data since it is provided by the "customers" of the VTET system.

2. National statistics:

Statistics provided by the PCBS including the basic population statistics as well as the socio-economic ones including household surveys and establishment surveys which will provide substantial amount of data on employment, wages and other economic factors which will have to be considered. It is also important to investigate the possibility of asking the PCBS to perform customised surveys benefiting from their statistical as well as field work experience.

3. TVET directorate contribution:

The directorate could also contribute to the overall monitoring system by conducting its own surveys. It is important here to point out that this should be done only when necessary and when no other party can provide the required information. However the tools that can be used by the directorate are:

- Employer surveys (primarily involving employers placed close to training institutions), providing feedback on perception of future demands for skills, and quality of training provided.
- Tracer studies of students in 1-2 years after graduation, looking at earnings, hours of work, spells of unemployment, employment rates.
- Reverse tracer studies, interviewing the employees within the occupation that a given training course aims for, to detect the number of employees that has previously benefited from that program. Furthermore respondents may be asked, about previous employment, schooling and training, in order to construct an occupational map of different paths into that occupation. Planners may then calculate the cost of the different paths, and thus determine the relative cost-effectiveness of different training strategies/programs.
- Annual reporting on the supply side describing what courses are taught, and by what capacities, the number of graduates from these different courses, geographical distribution of offerings and the number of applicants to different training courses and institutions

4. Other possible sources of information:

These would include publications of labour statistics in neighbouring countries, monitoring of changes in technology, and also analysis of national development plans.

4.4 Conclusion:

Labour market monitoring is possible. The limitations involved and the underlying uncertainties have to be understood beforehand to appreciate the difficulties and the sophistication of the process and thus the need to institutionalise it.

5. Implementation

5.1 Implementation Plan

The restructuring of the Palestinian TVET involves many different segments of the educational system, of the private sector, of the civil service and a great number of people. While the goals and the range of activities can be defined beforehand and some development lines can be planned in detail , some other lines must be kept on a more general level until further discussions and decisions have taken place.

The execution of the restructuring must be done by specifically appointed bodies which will be responsible to the ministries concerned.

The main subdivisions of the total restructuring plan are:

Physical Resources Development (PR)

Goal: to provide the instruction facilities, the teaching equipment, and the supporting administrative structure required for the size and the range of the instruction sectors as determined by the labour market analysis and as possibly modified by respective political decisions.

Labour Market Monitoring (LM)

Goal: to establish a monitoring system that can provide the TVET system determinants for the start-up phase and for the following gradual adaptation of the system output to market and society needs.

Human Resources Development (HR)

Goal: to provide the manpower for the required instruction volume and range. This includes teachers, administrators, and support staff, teacher trainers, and system developers, as well as the underlying development and administration structures.

Curricular Development (CD)

Goal: to establish a national curricular development system which includes segments for job profiling, development of curricular modules, certification and assessment, as well as the appropriate institutions.

Administrative development (AD)

Goal: to prepare and to support all required legal and parliamentary activities in co-ordination with the appropriate bodies. To plan and to execute all required financial activities for the system development and to prepare the groundwork for a sustainable national TVET system. To establish the administrative framework for the TVET system.

Co-operation with private sector (PS)

Goal: to initiate training boards in the private sector and to establish a national public-private consensus on and the required framework for the TVET policy.

Counselling and guidance

Goal: To establish a system of counselling and guidance, that is aimed at all of the different types of entrants, assisting the entrants in making the right choice of future occupation, and informing potential students about the possibilities of the system at hand.

Interconnections

Individual work plans for each of these sub-projects have been or will be developed, interlinkages will be determined and employed to establish a system master plan with a common time line. An appropriate interministerial body (e.g. an enlarged Expert Team, called Joint Planning Group) will be defined and charged with the supervision on this level and the enlistment or establishment of the executing agencies. It will have to monitor the development dynamics, ensure co-ordination between the different subdivisions , initiate intermediate evaluations and prepare required political actions and approvals.

Subsystems and Prioritisation

Several of those subdivisions contain preplanned check points or evaluation phases, at which there may be a limited change in development direction. The subdivision Physical Resources, however, does not contain any open questions, together with the Labour Market Monitoring it forms a nearly independent subsystem. Those two can and should be developed as soon as possible, in order to create the material foundations for the overall system development. The main arguments for such a decision are

- the Physical Resources development can be executed in a manner which does not adversely affect any reasonable curricular decision.
- any other sequence would extend the total reorganisation time intolerably.
- the required public acceptance of vocational training can only be built by providing TEVT institutions worth their name.
- the teacher training must be carried out on the equipment actually on site.
- the need for external funding for the initial PR upgrading involves an extended preparation period prior to the actual implementation.

Hence, the development of the subsystem PR and LM should be pursued immediately , and, to a limited extent, independently of the remaining subdivisions. Those two subsystems will be called technical and main subsystem in the following.

5.2 Implementation Mechanism

The restructuring of the TEVT is a national endeavour that requires political and parliamentary action. The current planning work by the Expert Team is only a small nucleus to get the process started and it will take about five years to reach the first development plateau. During this time discussions, decisions, and reappraisals of the policy to be followed will happen on all political levels, and the plans, and even the implementing agencies will change during this course. However, there is no alternative and it is imperative to get the process started by supplying the ministries concerned with a sufficiently broad foundation to move on.

5.2.1 Phases

The following phases of TVET system reorganisation can be defined:

Planning, Preparation, Decision, Structures, Implementation, Stabilisation.

Phase 1: Planning

The basic strategy for the reorganisation is discussed and formulated., the technical and planning mechanisms are detailed in a Reference Paper to assist the discussions and the initial versions of the main subdivisions work plans are developed. The three ministries involved agree on a mandate to start the development in areas of common agreement.

Time span: 4/96 until 2/97.

Phase 2: Preparation

The detailed work plans for the technical subsystem (Physical Resources and Labour Market Monitoring) are developed. An initial labour market survey provides the data for actual employment, manpower deficits, and an analysis between occupation and previous education which are all used to provide a reasoned estimate of the current and future training needs. The currently active TVET institutions are surveyed and their facilities assessed. The sectoral and regional demands for TVET Level 1 are determined and used to derive upgrading plans for teaching facilities and equipment. As the funding will certainly be done through foreign donors, the planning must be co-ordinated with them and the procedures for external funding be established.

Any projects to try out specific components or characteristics of the new TVET system can be carried out or initiated during this phase.

Time span: 12/96 until 8/97.

Phase 3: Political Decision

All politically relevant matters of the implementation process are prepared and presented to the proper political channels. The parliamentary process for the definition of the new TVET system will be concluded and the necessary regulations drawn up by the ministries concerned. The implementation agencies are defined and obtain a mandate for their work.

Time span: 6/97 until 12/97.

Phase 4: Structures

The institutional and manpower structures required for the TVET plan will be established: sectoral and general trade boards, curricular development groups, manpower training networks, administration bodies for the future TVET management.

Time span: 6/97 until 6/98.

Phase 5: Implementation

All lines of the TVET system reorganisation will be implemented according to the evaluations and decisions at that time. The execution may be segmented according to time, sector, or region as desired or required by relevant factors, such as funding, political situation, development speeds.

Time span: 1/98 until 2001.

Phase 6: Stabilisation and Assessmentt

The structures established, their functions and their coordinations will be tuned to achieve optimum efficiency. No major restructuring should be carried out for a limited time in order to concentrate on the system interconnections and the evaluation of the basic assumptions of the strategy and their validity. This plateau phase will be used for internal and external assessment of the work done and in order to change over from substantial to gradual system adaptation, especially to the population growth.

Time: about 5 years from the start.

5.2.2 Executing Agencies

Phase 1: Planning

The planning phase has been carried out up to now by the Expert Team, the remainder of the planning work can be done there as well.

Phase 2: Preparation

This phase can also be handled by the Expert Team. It should, however, be expanded significantly to provide the manpower needed for the enlarged load and it should reflect the main work lines (technical and main subsystem) in its interior structure. The group might preferably be repositioned as a Joint Planning Group (JPG).

Phase 3: Decision

This phase involves all levels of the ministries concerned and the legislative level for the fundamental structural decisions. The JPG will support this process and act as an interministerial liaison office.

Phase 4: Structures

As this phase involves legally relevant matters, it must be executed by a body responsible to the executive branches concerned. Depending on the political decisions and the development pace this could be an appropriately configured JPG or selected sections of the future TVET administration.

Phase 5: Implementation

By this time the future TVET system administration (directorate) should be functional in its main branches and ready to implement the main reorganisation plan.

Phase 6: Stabilisation

This phase will be handled by the TVET administration, the assessment will be the domain of the respective department. It might be advisable to enlist outside assistance for an objective view of the actual status and for the redefinition of the development goals.

5.3 Required Political Actions / Decisions

- The scope and the legal implications of the TVET system restructuring require explicit mandates to any agency taking part in this effort. On the executive level this will include:
- a mandate to continue the development process sketched out above–with or without the desired modifications
- the approval to implement the physical resources development on the basis of the labour market survey
- the organisational framework for the interministerial planning group (JPG)
- the time frame for the main phases of implementation
- the work plans for the subdivisions and the dates for evaluation and reporting.

On the legislative level the following matters must be finalised:

- the system structure and the component functions
- the system administration structure
- the curricular development authority
- the certification levels and regulations
- the teacher qualification structure
- the civil service qualification aspects.

Furthermore, political decisions are required for the following

- the total TVET system output for the 5 year plan
- the sizes of the major educational streams
- the population growth adaptation factor
- the skill export contribution
- the budgeting procedures for the initial development phases
- The permanent financing structure of the VTET system

6. Main Changes to the Present System

This chapter outlines the main changes implied by the strategy to the present system as far as administration, teaching facilities and curricula/supervision and quality assessment are concerned.

6.1 Administration

6.1.1 Establishment of Institutions, Committees, Councils etc.

The strategy outlines a management structure of the revised VTET system, which implies the creation of:

- A VTET Council
- An VTET Advisory Committee
- A National Training Fund
- A VTET Directorate

The institutions are the vehicles of transition, and it is therefore suggested, that these institutions are established as soon as possible, in order to facilitate the transition process. The consequence will be that the mentioned institutions will hold the responsibility, not only for the transformations process, but also for the administration of the present VT centres, VE schools and Community Colleges while the transformation is being implemented.

When establishing the institutions the following decisions will have to be taken:

Establishment of the VTET Council
Who will be the first chairman
Who will be members besides the three ministers
What will be the precise role of the council
Drafting of the statutes of the council
Establishment of the Advisory Council on VTET
Who will be the members
What will be the role of the council
What will be the statutes
Establishment of the National Training Fund (NTF)
Hiring of Director
Description of role
Budget
Physical placement of the fund
Hiring of staff
Purchase of equipment
Training of staff
Establishment of the VTET Directorate
Hiring of Director/deputy Director
Description of the function of the directorate
Establishment of the organisational structure of the directorate (what departments etc.)
No. Of Staff
Physical placement of directorate
Budget
Hiring of staff

Purchase of equipment
Training of staff

Concerning the VTET directorate, it might be noted that it makes sense to transfer the staff of the present VT directorate of the Ministry of Labour and the staff of the present VE department of the Ministry of Education to the new directorate, in order to preserve the knowledge and experience of the staff of these two institutions. This does not mean, that it might not be necessary to hire extra staff.

6.1.2 Tasks to Be Considered and Acted Upon by the Above-Mentioned Institutions

The following should not be seen as a complete list of tasks facing the institutions, but should rather be seen as a reminder of some of the most crucial issues. The topics listed focus mainly on matters related to funding, as this of course is of the utmost importance. The following list does *not* deal with questions that are mentioned separately in this paper, e.g. matters concerning structure, modularisation and labour market monitoring.

VTET Directorate

Drafting a budget for the operation of the entire system

- Costs
- Sources of financing

Initiating income-generating activities at the centres

- Rules
- Guidelines on how to start income generating activities, best practices etc.
- Establishment of a date by which all centres have to have income generating activities.
- Incentives: is all or part of the profit generated going to remain at the local Centre, or is all, or part of the profit to be transferred to the NTF.

Designing and initiating a system for the payment of student fees

- The size of the fees
- Should certain groups of (disadvantaged) students be exempt, and if so–which
- How to collect the fees
- Development of a system of revolving student loans

Establishment of Administrative procedures for:

- Payment of salaries
- Purchase of teaching materials
- Transferring results from labour market monitoring into decisions on how many, and which courses to teach at the individual Centre, and all together.
- etc.
- Decision on level of decentralisation, what decisions are to be taken at the central level, and which at the individual centre.

VTET Council

- Approval of the Budget
- Decision on the appropriate mix between the five sources of income mentioned above
- Negotiations with the Ministry of Finances on the provision of the Government funding

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- Approval of the guidelines for the reception of donations and grants
- Approval on the guidelines concerning the level of decentralisation
- Approval of the guidelines concerning student fees
- Approval of the rules on income generating activities

NTF

- Negotiations with the Ministry of Finance on the provision of the Government funding.
- Liaison with the Department of Taxation on the Levy/tax on employers

Design of the tax

- How much
- Should any employers be exempted, and if so—who
- How to collect the tax
- Etc.

Development of guidelines for the reception of national and international grants and donations.

- To which extent may the donor decide on the final use of the funding provided

6.2 Teaching Facilities

The present VT centres, VE schools and Community Colleges will be transferred to the revised system, essentially meaning, that they will come under the authority of the VTET Council, and the day to day management of the VTET Directorate. It is foreseen that the revised system will be based on a limited number of regional centres. The number has to be relatively limited in order to ensure that each Centre has the sufficient size required to execute modular training, with several shifts (please see section 2 on modularisation).

It is envisaged, that the number of VTET level 1 institutions (please see section 2 on structure) will be about 10 on the West Bank, and slightly less than that in Gaza. The centres will be placed in major population centres, and will deliver training based on the regional demands.

Transferring the teaching facilities of the present VT, VE and CCs to the new system will not necessarily result in an adequate and efficient distribution of institutions.

Furthermore, it is suspected, that several of the present institutions, especially of the VT system are substandard, and might have to be sold off, as it will not be viable to remodel them. Consequently an evaluation of the VTET 1 (the former VT and VE) institutions should be carried out, determining which ones should be remain unchanged, remodelled or sold off.

As it is foreseen that the overall capacity of the system will have to be increased, compared to the combined capacity of the present VTs VEs and CCs, the teachers of those institutions could be transferred to the new institutions, although extensive training will be required, as a consequence of a) the introduction of the new curricula and b) as no extensive teachers training has be carried out during the past years.

6.3 Curricula/Supervision/Quality Assessment.

For obvious reasons it is clear that the public VTET institutions should teach according to fully unified curricula (as soon as the modules have been developed—please see the chapter on modularisation). However, this does not address the question of how to involve and co-ordinate with the private and NGO institutions.

The strategy states that:

> "It is important that all training provided leads to qualifications that are recognised nationally; in order to ensure a transparent training system. This means that the government should involve all training providers in developing curricula and testing and validation measures. Once these are developed, all training providers will be offered the use of the curricula and admission to the national testing system.
>
> The involvement of the other providers in the development process means that this process will benefit from all resources available not only those of the government."

It is however possible to envisage an even closer co-operation with the NGOs and private institutions. Especially it seems obvious to offer these institutions the usage of the teaching facilities of the public institutions, when they are not utilised, for instance in the evening, if warranted, against payment from the borrower.

Further more, it should be attempted to co-ordinate the teaching offered by the different types of institutions, in order to ensure a combined output that matches the demands of the labour market, as determined by the labour market monitoring measures, as well as possible.

Women and Education in Lebanon

Mrs. Bahia Hariri

Member of Parliament and

Chair of the Parliamentary Education Committee

The Republic of Lebanon.

Excellencies, Ladies and Gentlemen:

The issue of education is, in itself, a national developmental one, in that it has the natural role of spreading the culture of a nation and asserting its national identity. We, in the Arab world, consider our human resources as our greatest asset. The best means of building a brighter future for our world is by enhancing its educational and cultural status.

The aim of this conference should be to seek the most successful means of developing the human resources of our Arab world, and to make the most of those that have the greatest potential to contribute in this field, making it possible for the Arab society to meet the future challenges.

The status of Women and Education:

"...Education is a human right and a basic means of achieving the aims of equality, development and peace." (Pikin, September 1996) Yet societies in the Arab world still suffer from the problem of illiteracy in general and illiteracy among women, in particular. The percentage of illiterate women varies from one Arab nation to another. Many reports have revealed that several Arab nations are giving priority to programmes which eradicate illiteracy among both men and women. The Gulf states are distinguished for the reduction in illiteracy percentages that they have achieved in comparison with other Arab states. This is perhaps due to their better financial status and smaller populations.

The constitutions and regulations of Arab nations maintain the right of women to be educated and to be given equal opportunity with men. However is this applied practically?

The curriculums in most Arab states do not have any reference to the concepts of equality and justice between the sexes and most school textbooks still portray a somewhat blemished view of the role of women in society. However, Arab nations have achieved, in the last two decades, some noticeable progress in education in general, and in the education of women in particular. These two decades have witnessed a rise in the number of people being educated and in the number of employment opportunities being offered. In addition, several laws were passed which increased the contribution of women in the workforce and gave them some equality regarding their duties and rights.

If we look beyond the statistics, we may deduce that education, as a social system, emerged to accommodate to the existing traditional society. We also deduce that evaluative perspective towards changing the educational system is not linked to sufficient guidelines. Available statistics prove that the percentage of people studying varies from one Arab country to another, but the percentage of females studying is commonly lower.

Despite the fact that education in the Gulf states is relatively recent, some of these states are distinguished for the rise in the number of females being educated, and a good example is that in the UAE there is no difference in the number of females and males enrolling for elementary education. Whereas the percentage of females enrolling for the same stage is less than 10% in Syria, Lebanon, Bahrain, Jordan and Qatar. This rate is gradually rising in Kuwait, Tunisia, Iraq, Algeria and Libya and rising at a greater rate in Saudi Arabia, Sudan, Morocco and the Yemen.

If we observe the rise in the number of females graduating from secondary schools, we note that most of them enroll in Faculties of Art and Humanities while only a few enroll in applied sciences of technical colleges.

As for the enrolment of females in technical education, we note that the rate of females is much lower than that of males. Technical training is one of the most important means of assisting in the improvement of skills necessary in the work market. However, the criteria for implementing such training in the Arab nations has varied. Some have followed the process of regular technical teaching while others have encouraged the role of foundations and non-government organisations in aiding such education. Whatever the process followed may be, I believe that all fields of technical education should be accessible to Arab girls.

Choosing the option of technical education is influenced by many factors, the most important of which is a foreseeable view of the prospects for the role which females may play or may be set for them.

The most significant factors which stand as obstacles for Arab girls to enroll in a school or quit school early are:

- Traditions which hinder the principle of developed laws and obstruct their application
- The incomplete application of these laws and regulations
- Not complying with the policy of compulsory education.
- The fact that education is directly related to the financial situation of a family and the way this affects mainly the female. Such that recent studies mention poverty in terms of gender.
- Not exploiting education for employment and not planning in accordance with a scientific approach.
- The rate of female learning is affected by certain geographical areas such that it has fallen greatly in the rural and less developed areas.
- The great rise in the population of some Arab countries.
- The wars which have been waged in the region such as the war in Lebanon which lasted for seventeen years, the Iran-Iraq war and the Gulf war which led to a great waste of the areas and resources and restricted its development.

In all of these difficult circumstances, the woman received her share of the negative consequences and was even deprived of the opportunity to be educated.

The accord of national reconciliation calls for the achievement of overall and equal development. The Taif Agreement defined the foundations for peace and stability in Lebanon. Education is the most significant cornerstone for the reconstruction of the country and its human resources after a long war which strained the nation's people and foundations.

The rise in the number of females attending schools led clearly to an improvement in the education of females but illiteracy remains a major problem even though the rate of illiterate women in Lebanon has been reduced significantly in the last twenty-five years, in that in 1970 it was 43.3% whereas in 1995 it became 17.8%.

The educational status of women in Lebanon has improved tremendously in the last twenty-five years and this is a result of the developed participation of women in the economical and social life of the country making them a vital pillar in the productivity of the country.

The latest survey of the Centre for Educational Research and Development revealed that the number of students in public schools was equal for males and females.

The survey also showed that the number of females enrolled in technical schools at the intermediate and secondary level had increased significantly.

In universities, most females pursue their studies basically in the field of humanities but they are leaning more and more towards fields which are less general and more technically specialised. Despite the negative impact of the Civil War on the status of the Lebanese University, women were still able to enroll in university and thus participate effectively in the development of social life in general.

Lebanese women play a vital role in education; around fifty-three thousand women today occupy different posts in this field. According to a statistical survey held in 1996, 63.1% of the employees in education were women, 14% of which were teachers. That makes 68.9% of the total number of teachers in Lebanon in general; which is 70.4% of the total number of teachers in the elementary and intermediate levels. This percentage lessens as we move to upper levels until it reaches the ratio of one to four (one female to four male teachers), at the university level.

At this stage, it is important to call attention to the educational renaissance which was decided upon by the Lebanese Cabinet on August 17, 1994. This made it possible for a new educational system to rise in January of the year 1996. This new system ensures and clarifies the promotion policy from one level to another. In addition, it guarantees a smooth movement between the official regular learning programmes and the vocational and technical ones.

The mentioned plan ensures elementary education for all children and makes it compulsory. Thereby making public education a major national concern which everyone will work on improving in order to achieve our main goals: some of which are:

1. Providing modern public schools which accommodate the national economical and social needs of the country, and reflect the latest technological development.
2. Focusing on the importance of providing a national education, especially after the long and severe civil war.
3. Amending and unifying the educational programmes so that they assert our national identity and reflect the equality of males and females in the reconstruction of the nation.

4. Offering equal opportunities for all children to learn and enroll in schools.
5. Educating the children affected by the fighting in Lebanon.
6. Meeting the special needs of the war casualties and rehabilitating the handicapped.

Ladies and Gentlemen:

Despite all the obstacles, we note that as a result of the developed social, political thought, the scientific and technological advancement, and the way in which Arab women's awareness has gradually improved. Thus we can say that the status of the Arab Women in general has changed on the economic social, vocational and legislative levels. She is now contributing positively in the general development of our region. On the basis of all that has been said, we feel it necessary to make a few suggestions to improve education for women:

a) Establishing a guide that forms the proper framework for a strategy enabling educational development, and making elementary education widespread and compulsory.
b) Applying a policy for eradicating illiteracy.
c) Educating women in accordance with our general goals.
d) Improving programmes for planning and administration so that they meet the needs of the job market.
e) Ensuring equal opportunity in the fields of education and specialised training.
f) Improving the positive image of women's status and role in our educational programmes.
g) Encouraging technical education and assuring the essential conditions for it.
h) Having a comprehensive educational policy that goes hand-in-hand with a media policy so that together they serve the goals of the system at all learning levels.
i) Working on acquiring skills that improve productivity in general.
j) Controlling the number of female drop-outs, especially at the elementary level.
k) Encouraging research and studies which promote a better way and status for the Arab female.
l) Working on ensuring the positive coordination among the Arab countries in the educational field.

I wanted to elaborate more on the topic of this conference but the time limit does not allow. I have tried to shed light on the status of Arab women and the stages they have gone through in the fields of education. Although she has faced many hindrances, the Arab woman has proved herself and played a positive and practical role in the educational process both in learning and teaching.

The scope of the responsibility which Arab women hold in the educational field in this age of communicational and informational development, confirms her natural understanding of the role of education in future advancement, and her role in that process. We consider it essential that women continue to play this role and help in guiding Arab societies towards modern development.

This mission assumes that the participation of Arab women becomes a complete one in all the fields of development, keeping in mind, that the future of the Arab world relies on the extent to which equality amongst its citizens becomes a basic principle in applying all its potential for the sake of developing its human resources.

Facing the future challenges in the social, economical and cultural conflicts with the Israeli enemy, makes unifying all our efforts a necessity. It is worth mentioning here, the recent freeze on normalising relations with Israel which Arab Foreign Ministers agreed on.

From this lectern, I call on all the honourable people of the Arab world to take part in the commemoration of this painful memory on the eighteenth of April, and denounce this Israeli aggression and carnage, calling for the immediate implementation of the United Nation Resolutions, and specifically Resolution 425 which calls for the complete and unconditional withdrawal of Israeli forces from Lebanese territory.

I hope we can all work together to achieve a just and comprehensive peace in the region.

Thank you for your attention.

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Women—the Untapped Resource: What are the Questions We Should Ask? Inquiring into the Past and the Present to Guide the Future

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Summary

Human nature, particularly when technology is involved, is too often driven by problem solving, by the 'doing' side of us, and then reported as descriptions of the 'doing'. It is suggested that when topics of central importance such as nation-building are considered, it is vital to apply observation, reflection, and the pursuit of understanding as well as the pursuit of solutions to apparently obvious problems. Four frameworks for this activity are suggested as viewing lenses, vistas, viewpoint and visibility. The resulting insights may enlighten both policy makers and practitioners, with the intention of enabling them to make fundamental change and development decisions in regard to women, educational technology and national development.

> Technology is only a direction; it should not be difficult to redefine this direction for social ends. *Edward de Bono*

What IsUntapped?—The First Question

Sometimes the first place to start is with what we assume to be common knowledge. For example, should we look at two definitions of technology from dictionaries of similar size:

> *Macquarie Dictionary [Australian]:* the branch of knowledge that deals with science and engineering, or its practice, as applied to industry; applied science. 2. the terminology of an art, sciences, etc.; technical nomenclature. From the Greek *technologha* for systematic treatment
>
> *American Heritage Dictionary*: 1a. the application of science, especially to industrial or commercial objectives. b. the scientific method and materials used to achieve a commercial or industrial objective. 2. *Anthropology*. The body of knowledge available to a civilisation that is of use in fashioning implements, practising manual arts and skills, and extracting or collecting material. From the Greek *tekhnologia*, systematic treatment of an art or craft.

We find that although similar, these definitions express some different points of view. The *American Heritage Dictionary* includes a dimension of commercial concern missing from the *Macquarie's* perspective. Is this a reflection of the points of view of the two sets of authors, or of a more widespread cultural (or national) view? What effects would these variations in view have on, for example, setting priorities for technology education? What other points are raised for us to consider about technology? Its contribution to civilisation? Its systematic approach?

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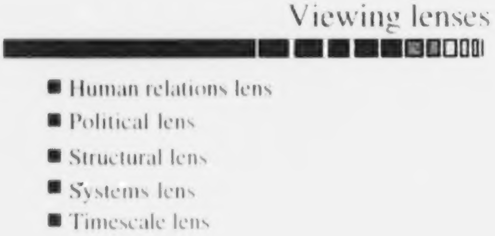
What about gender issues? There is no gender statement in either definition. Is that silence important? The placement of this session at the beginning of TEND 97 suggests a discrepancy between theory and practice, and that alone is worthy of further questions.

The answers to the range of questions emerging from consideration of the above definitions are less important (at the moment) than that we should take cognisance that questions need to be asked at many levels when considering technology, much less when associating it with women and with education. What other questions are needed? How can they be framed?

The aim of this conference is to consider technological education and national development, an endeavour on a grand scale, and one concerned with innovation, change and development. Human nature, particularly when technology is involved, is too often driven by problem solving, by the 'doing' side of us. Although problem-solving is a critical aspect of change and development, it is insufficient. Understanding achieved through observation, inquiry and reflection which is then communicated in ways to enlighten both policy makers and practitioners is also essential (Weiss 1977, 1982; Schon and Rein 1994). This paper proposes consideration of the viewing lenses, vistas, viewpoint, and visibility of women, technological education and national development. The presentation will raise some questions for policy makers and practitioners concerned with women and technology in the context of the conference's theme of nation building.

Viewing lenses



Viewing lenses

- Human relations lens
- Political lens
- Structural lens
- Systems lens
- Timescale lens

One way of looking at the whole is to think in terms of using different lenses for viewing the arena of interest. Five frameworks which could be used as focal lenses for inquiring into and interpreting women and technology in national development include (drawing on Yanow 1990 and Fasano 1993):

1. The human relations lens, which looks at the behaviour of individual actors within organisations and traits of interpersonal behaviour;
2. The political lens, which examines dynamics within groups and relations between and among groups;
3. The structural lens, which focuses on the organisation itself as a design set of behavioural rules;
4. The systems lens, which targets organisations as they relate to one another in a particular environment;
5. The wide angle lens of time scale which formalises the need to consider the policy space over a useful period of time.

Vista

Holistic
Application, organisation and management
Multi-level
Networks
Learning processes
Integration of diffusion
Monitoring and evaluation
No single answer

Vista

Another perspective is the vista when we consider the landscape of technological development. A framework for thinking about technological development should include (adaptation of points reported by Fasano [1989, pp.12-13] from a study of technological innovation by Scott-Kemmis et al. [1988]) these attributes:

- an holistic approach – innovations must not to be considered in isolation from their environment
- at the micro-level change involves innovation in both organisation and management as well as in the immediate application of the technology
- no one scale is 'the appropriate scale' so an open multi-level approach is needed.
- networks of interrelated groups within an industry (including both commercial industries and the education industry) and between relevant industries are as important to success as the capability and strategies of individual firms and organisations
- learning processes at several levels of the system (e.g. working/learning group, organisation, industry) play a key role
- the diffusion of innovation is not a passive process but must be an integral part of development
- long-term planning should include monitoring of the diffusion and evaluation of the technology and its users, within a multi-dimensional framework of analysis
- innovation in industry does not follow a unique developmental pattern – there is no single pattern or formula

Viewpoint

Viewpoint

Taking an holistic view of the policy and practices regarding women and technology requires identifying the stake holders (any person, group, or organization that can place a claim on an organisation's attention, resources, or output, or is affected by that output (Bryson 1988), the policy actors (those directly involved in policy making and implementation), the apparent and underlying content of the policy, the beliefs and values held by the actors, and the boundaries and constraints which exist. What is the viewpoint of those involved? Where do they stand in regard to the issue?

Visibility

The previous three approaches turned attention to *something*. What is absent? What is not being seen? What is not being heard? These questions are as important to understanding for change and development as those about what is visible to all and heard by all.

Your Challenge

The use of technology is a social decision, whether it is made explicit or not. This conference has clearly associated the social issues of nation-building and education with the use of technology. The placement of a session on women as the first session after the conference's keynote speaker signals that the role of women in this arena is considered important. For that reasons, I suggest to you to look for women's place on the agenda of the remaining presenters.

In conclusion, to ensure that women do not remain an 'untapped resource' nor that technology remains an untapped resource in the unleashing of the full potential of women, may I offer these challenges:

Your Challenge

- First, consider each TEND97 in the light of the frames suggested here.
- Second, on return to your own situation, examine the policies and practices regarding women, technology and education using these frames.
- Third, regularly examine your viewpoint and practices using the frames.

At least you will gain new insights into the nature of the challenge; at best you will develop new insights and develop new strategies for nation-building supported by women and technology leading to improvement in all the attributes of effective nation-building.

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Higher Education and the Emerging Role of Women in the UAE

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Women are becoming an increasingly important part of the labour force in most places in the world. For example, since 1980 women have accounted for three-fifths of the increase in the labour force in North America, and two-thirds of the increase in Europe. This is true of most countries in the Middle East, although the percentage of working women is lower in the Middle East and North Africa than anywhere else in the world. However, it should be noted that women in the Arab world suffer from 'invisibility' in that large numbers work in agriculture, family run businesses, the domestic economy or elsewhere in the informal economy, yet they are not considered employed.

It is also true that education is playing an increasingly important role in preparing the labour force in a knowledge-based high tech world. In 1970, there were more blue-collar workers than white-collar ones in more than half the OECD countries; by 1990, that was true only in Spain. This is true for both men and women, young and not-so-young. This means that more people of all ages are attending higher education and taking advantage of life long learning opportunities. It is also the reason why Sheikh Nahayan bin Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, created the Higher Colleges of Technology (HCT) in 1988.

With more women working and higher education becoming a prerequisite for getting a good job, it is not surprising that women are flocking to higher education throughout the world. For somewhat different reasons, the same trend is happening in the UAE. For example, of the Emirati children starting school in the early 1980's about 60% of the girls and 30% of the boys eventually entered higher education. The HCT now has over 5,000 students in eight colleges, the largest of which is Dubai Women's College with 1,300 students. The UAE University has about 12,000 students and well over half are women. It is also interesting to note that girls outperform boys at every level of school in North America, Europe and certainly in the UAE. This is also true in many subjects at university. These trends of more women working, higher education becoming more important for job success, more women attending higher education and women outperforming men in education, will have serious implications for the increased Emiratisation of the labour force.

The dramatic economic and social development in the UAE since the discovery of oil has been accomplished by visionary leadership and expatriate knowledge and labour. There is much talk about intensifying the knowledge of different sectors of the economy and decreasing the dependency on expatriates. If this is to happen, there are problems and challenges ahead and many potential opportunities for educated women. One obvious problem is that there are only about 600,000 Nationals or about 25% of the total UAE population. Only 196,000 of these are between 20 and 50 years of age, only 25,000 have degrees or diplomas and another 21,000 are presently in higher education. If all of these people wanted to work and had degrees in appropriate subjects, there would still not be enough to replace and add to the existing white-collar expatriates. The 57 percent, or 340,000 Nationals, below the age of 20 represent an enormous challenge to the country's human resource planners. If they are educated, have the motivation to work in the private sector and are provided with opportunities, they could satisfy many of the human resource requirements for Emiratisation and growth in the knowledge dependent sectors. Eliminate the 50% who tend to be the educational high achievers, i.e. the women, and there are not enough Nationals to meet the country's demand. This is compounded by the fact that not everyone is suited for higher education and the knowledge dependent sectors of the economy. If Emiratisation is going to be successful and if the UAE is going to take its place alongside countries like Singapore, then educated Emirati women will be needed as key participants in all sectors of the labour force. Consequently preparing young women for work has become a national priority, as evidenced by the rapid growth of the Higher Colleges of Technology Women's Colleges and the number of women attending UAE University.

It is encouraging to note that about 65% of the HCT female graduates are currently employed and employers are seeking more graduates. It is even more encouraging to see the types of positions they are getting, hear the positive feedback regarding their work performance and witness their work related enthusiasm. Dubai Women's College graduates are impressing their employers in organisations like Citibank, British Bank, Emirates Bank International, Mashreq Bank, EPPCO, Emirates, Dubai Municipality, Dubai Economics Department, Dubai Health Department, ETISALAT and many others. It is fair to say that most female graduates are being employed by the public sector and hopefully this will become more balanced with the private sector in the years to come.

But educating women for the labour force is not just a matter of national needs. It is about personal needs as well. As lifestyles change, the role of women also changes and their responsibilities and challenges change. Many of them will need work outside the home in order to get meaning and challenges from life. Also, as the economy matures, it will probably become more difficult to become wealthy, yet the 'competition' to maintain high standards of living will continue. This will mean that two income families may be necessary for younger people to get started and 'survive'. Another important consideration is what happens to people who lack the focus that education and work gives to life. Already there is serious concern about teenage delinquency, crime, drugs, road accidents and school dropouts. These concerns usually start as individual cases dealing with boys and then quickly spread to a national issue involving both boys and girls. Higher education and jobs can and should play an important role in solving these problems.

The Impact of Rapid World Technological Changes on the Polytechnic in Africa in the 1990s and beyond

HE Mr. Elifa Ngoma
Secretary General
Commonwealth Association of Polytechnics in Africa

I bring to this historic conference, felicitations and messages of goodwill from the Board of Management and the entire membership of the Commonwealth Association of Polytechnics in Africa. I wish to add my voice to the many that have congratulated the Minister of Higher Education and Scientific Research, HE Sheikh Nahayan bin Mabarak Al Nahayan and the conference committee for the manner this conference is organised.

Introductory Remarks

When the organisers of the TEND 97 Conference asked me to come and talk about issues of Technological Education and National Development as seen, felt, and reacted to by the Commonwealth Association of Polytechnics in Africa (CAPA), I accepted the invitation without any hesitation. Issues concerning modalities of travel and work schedules at the CAPA Secretariat were put on the back burner.

All this because of the rare opportunity this conference offers us in the African polytechnic to share our deep-rooted concerns and views about current and seemingly future technological trends in the world, with special reference to the developed segment of our world. It was clear to me that my coming to this conference would enrich our understanding of the changing meaning of technological development.

My presentation this afternoon will attempt to give the conference a glimpse of what CAPA considers as issues that impeded effective delivery of technical education and training in the African polytechnic in the past two decades, and how we went about trying to resolve these issues. I will also try to portray a picture of the African polytechnic that has lost its mission in the face of today's rapid technological changes in the world. Lastly, I will attempt to share with the conference, reactions of the polytechnic in Africa to the world trends that, though well-intentioned, are dealing death blows to the African polytechnic, leaving it emaciated and utterly disoriented.

Ladies and Gentlemen, let me take the remaining minutes to deliver the gist of my paper and invite your reaction.

Information about CAPA

It seems necessary to preface my address this afternoon with information on the Commonwealth Association of Polytechnics in Africa (CAPA). What it is, what it stands for, what it has achieved, its frustrations and the Association's contemporary concerns.

The Commonwealth Association of Polytechnics in Africa has its Secretariat in Nairobi, Kenya. CAPA has a membership of 143 polytechnics and high level technical colleges scattered across 17 African Commonwealth countries of Botswana, the Gambia, Ghana, Kenya, Lesotho, Malawi, Mauritius, Namibia, Nigeria, Republic of South Africa, Seychelles, Sierra-Leone, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

The Commonwealth Education Conference, originally called Commonwealth Education Ministers' Conferences, but later broadened to include experts, are the ones from which CAPA originated. During the Seventh Conference held in Accra, Ghana, in March, 1977, a recommendation was made that an organisation grouping together polytechnics be formed in the Commonwealth, but with a mandate for the African region only. It was expected that the organisation would play, at the polytechnic level, the role played by the Association of Commonwealth Universities at university level. After planning meetings organised in Freetown, Sierra-Leone and Nairobi, Kenya, by the Commonwealth Secretariat, but involving officials from education ministries and polytechnics in Africa, the organisation was launched in December, 1978, in Nairobi, under the name of the Commonwealth Association of Polytechnics in Africa.

The aims and objectives of CAPA focus on the development of technical education and training and transfer and development of technology in the African region.

The administrative Secretariat of CAPA in Nairobi, was established in 1982. The Secretariat co-ordinates the functions of the Association and takes the initiative for project development, fund-raising and identification of areas that need addressing within the member institutions, in line with the mandates of the Association. It is headed by a Secretary General sponsored and remunerated by a commonwealth country. The first Secretary General was a Canadian, the second a Kenyan, the third a Nigerian, and now the fourth, a Zambian.

CAPA derives its role from its mandate as spelt out in the Association's constitution. However, there are many ways of translating a mandate into reality. The broad concepts of improving technical education and training, and contributing to the development and transfer of technology, can be made concrete through a multiplicity of channels. For instance, some of the large well-endowed development agencies go to the extent of building whole campuses and workshops and equipping them. They also provide bursaries and scholarships as well as substantial research grants. The same is done by governments of developed nations in bilateral programmes. A small regional network like CAPA has neither the financial, nor the technical capability to contribute to development in that way. The question then is how does CAPA translate its mandate into concrete contributions in the area of technical education? I will illustrate this by citing a few happenings:

In 1980, CAPA initiated steps to identify directions in which actions could be taken to ensure that the Association realised some of its aims and objectives. A needs analysis exercise was conducted which identified six key areas that needed urgent attention. These were:

- Human Resources Development through training workshops and seminars.

- Establishment of a full-time Secretariat to be the future focal point for needs analysis, project development, fund-raising and project implementation on a continuous basis.
- Publications and information dissemination.
- Establishment of a documentation and reference centre.
- Promotion of research and consultancy.
- Facilitation of staff and student exchanges amongst member institutions.

Subsequently, positive results were recorded in three areas, namely: training workshops, establishment of the secretariat and publications. Thus from 1980, the Association started mounting training workshops in different locations in Africa. The funding support for the workshops came initially from CIDA and two years later was supplemented by the Commonwealth Secretariat and Commonwealth Foundation.

The CAPA Secretariat itself was established in 1982 with funding support from the Canadian International Development Agency (CIDA) and facilities provided by the Kenyan Government at the Kenyan Polytechnic. A newsletter was launched in 1983, using support from the Commonwealth Foundation, and later, also supported by other donors.

Of the remaining three areas of concern, some modest achievements have been recorded in the area of staff exchange. We are yet to secure funding support for a documentation centre. So far CAPA has supported research within the limited sphere of the problem area of women's participation in technical education and management. Major successes have been recorded by CAPA in the area of human resources development, through workshops and seminars.

A brief survey of workshop programmes from 1980 to present times is as follows:

- A workshop on technical teacher education in collaboration with the Commonwealth Secretariat was organised in April, 1980 in Mombasa, Kenya.
- A series of professional and management training workshops in collaboration with Canadian Colleges and with the funding support of CIDA, the Commonwealth Fund for Technical Co-operation (CFTC), and the Commonwealth Foundation (CF) were organised in the period 1981 to 1984. Many locations were used including, Nairobi, Dar-es-Salam, Blantyre, Lusaka, Lagos and Banjul.
- A workshop on financial management in polytechnics (Cost-Benefit Analysis) was supported by the World Bank in 1984, in Kitwe, Zambia.
- Another series of management development workshops in collaboration with the Further Education Staff College, Coombe Lodge, came up in Bristol in the period 1985 to 1987. Funding was from the British Council, CFTC and CF. Workshop venues included Harare, Zimbabwe; Logos, Nigeria, and Arusha, Tanzania.
- In 1985, CAPA initiated a training programme on personnel management. This was in collaboration with the International Labour Organisation (ILO) and the first training was at the ILO Turin Centre, Italy in April, 1987. Regional workshops were held in Dakar and Mombasa in July, 1987. Another workshop focusing on staff appraisal and evaluation was again conducted in Turin in October, 1989.

- Professional development workshops for in-house polytechnic staff development officers in collaboration with Canadian Colleges with the support of CIDA were mounted from 1985 to 1990. These were conducted in several locations throughout Africa.
- A series of workshops for the improvement of the relevance of given curriculums in polytechnics was conducted between 1990 and 1993.

In 1988, the Association shifted the strategy from using external facilitators to training its own resource persons. Thus in September, 1988, the Eastern and Southern African Management Institute (ESAMI) was contracted to train 15 facilitators for CAPA. These were selected from amongst the senior staff of CAPA member institutions. The funding support came from CFTC and CIDA.

In the period after the ESAMI workshop, 1989 to 1994, CAPA conducted several Senior Management Workshops using the graduates of ESAMI training, as the resource persons. The funding for these workshops came from various sources including CIDA, the Commonwealth, United Nations and African Governments. Two more workshops were conducted in 1992 and 1994 under these series. The locations included Accra, Ghana (1989 and 1994); Eldoret, Kenya (1989); Mbabane, Swaziland (1990); and Nyeri, Kenya (1992).

Also from 1988, the Association adopted a new focal area concerning the promotion of women's participation in technical education. A special project called "Women in Technical Education" was developed and implemented from 1988. Within the context of human resource development, a number of workshops was implemented from 1989 to 1994.

Also in 1988, CAPA adopted the promotion of Entrepreneurship Education as a focal area to address the problem of unemployment of polytechnic graduates. The first step was the sponsorship of 18 polytechnic staff for a 12 week course at the Entrepreneurship Development Institute of India in Ahmedabad. These 18 have since conducted several training workshops at country or regional levels in Africa. Several African governments, through their polytechnics, have since incorporated entrepreneurship in their technical training programmes.

A total of over 1,500 African senior polytechnic staff have been trained through the above workshops. But for the fact that CAPA serves a very large constituency, that number of persons trained could have had a very visible impact.

It should be obvious from the workshop themes above, ladies and gentlemen, that CAPA has been strongly pre-occupied with the issue of improving management of polytechnics. Training and workshops was considered the most powerful weapon for contributing in this direction.

Rapid Technological Changes

Recent world trends in technological development, re-enforced by enlightened predictions by professionals that *two thirds of the technologies that will be in use around the world in thetwenty-first century have not yet been invented*, prompted CAPA to organise an International Colloquium in Bulawayo, Zimbabwe, from 6 to 12 January, 1996, to analyse technological issues. Attended by nearly all the institutions in the CAPA system, the colloquium analysed the short-term impact of rapid technological changes on the polytechnic, industry, and government in Africa. Some of these were the following:

At Polytechnic level

- The existing training equipment and machinery has become largely irrelevant and obsolete, such that the task of attempting to re-focus training programmes to make them responsive to prevailing changes, is a non-starter.
- Training programmes and curriculums need regular reviews to match them with the rapid technological changes.
- Lecturers and instructors in the African Polytechnic lack relevant skills to handle the changing environment and ought to undergo regular re-orientation or bridging courses. CAPA Secretariat to decide where and by whom these bridging courses should be conducted.
- Text Books in use are mostly outdated.
- Graduate technicians and technologists from the polytechnic are foreign to technologies in use by industry.

At Industry level.

- Industry is being modernised at a very high cost and is consequently 'retreading' both skilled and unskilled old workers. It needs a new brand of technicians and technologists who have the ability to service the modern equipment and have also the orientation to act as agents for technological change.
- Industry is reluctant to support the training of technicians and technologists in the polytechnic.
- Most industries will not allow polytechnic students to work for them during college-supervised industrial attachments for fear that the students may destroy their expensive new equipment.

At Government level.

Ostensibly, because of the IMF Structural Adjustment Programme, governments do not have the financial capability adequately to fund, let alone procure, modern training equipment for the polytechnics.

Because in many cases, they are liberalising their economies, the governments, which control and fund the polytechnics, do not have the urge to make heavy capital investments in an area that is about to be transferred to private hands.

Exposition by John E. Leech of WFTO

In his paper delivered to the Bulawayo CAPA Colloquium in 1966, the Secretary General of the World Federation of Technology Organisations quoted extensively from passages he had read in the futuristic magazine ***1996** and Beyond* relating to future forecasts of technological developments in the world. I have Mr. Leech's permission to share what he told the CAPA Colloquium, with delegates at this conference. I quote from Leech's Paper:

> *Future Focus*
>
> What will our world look like by the year 2020 and what will be the jobs for the 21st century? Evidence of increasing pace of technological change is all around us. Offices have been transformed by computers, faxes, e-mail and voice mail. Everything from car to kitchen gadgets incorporate the latest

technological advances. Who will provide the skills to design, manufacture, install and maintain the ever-increasing expert systems?

What the future holds is difficult to tell but technology no doubt will shape what is to come. I had the opportunity to read recent future forecasts of technological development including excerpts from the futuristic magazine *1996 and Beyond*. I would like to share some of their predictions because it sets the context for what we need to do to prepare for the next century.

Demographics

Demographics in developing countries will account for the growing share of the global population. By 2030, developing countries could represent 87% of the world's- people. Both China and India alone will have a combined population of 2.5 billion near the year 2000 of a current total world population of 5.7 billion. If current fertility rates remained unchanged the planetary population could reach a staggering 691 billion.

Interactive Multimedia

Interactive multimedia will become the new tool of education. For the students of tomorrow, the traditional blackboard will be replaced by text, graphics, sound animation, full-motion video and other formats. Intelligent tutoring systems should become common place in schools after the year 2000 as supplements to teachers' instruction. Such systems would augment their instruction to suit the student' s level of understanding.

Distance learning

In a decade or so "weird" institutes and colleges will compete to tap the best minds around the world for ideas and knowledge, which will then be distributed to students, corporations and other clients. Electronic links and distance learning (currently happening), could also help schools co-operate, as nationals strengthen their economic ties through various agreements.

Schools and industry will realise the importance of maintaining an ongoing relationship so curriculum is not lagging behind technology. This will ensure that knowledgeable workers can keep up with technological advances. In the future, students and faculty will work together to design curriculums that best met community's present and future needs.

Education packages

Education packaging will provide new possibilities for students for the next century and will take on a number of promising forms. Video cassettes that can be viewed on a television set will allow the opportunity to take a fully packaged course that can be viewed in non-traditional places of learning such as in prisons, hospitals and senior citizen homes.

The education packaging industry will fast emerge as the alternative to delivering education by combining multimedia, holography and Hollywood style production devices to complete the package.

Information highway

Consider satellite technology that will deliver over 500 channels and provide entertainment, information and a variety of other services. This, along with the development of the information highway, a network that connects millions of computers to a variety of data bases and people from around the world, will have an impact on all our lives.

Reality of Situation

As can be imagined, ladies and gentlemen, this exposition by Mr. Leech bemused African Polytechnic principals at the CAPA Colloquium. None-the-less, it

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thereby making the world look like one little village headed by technology. Increasingly, the centrality of technology education and training as a medium to bring about equitable and sustainable development to all mankind around the globe, is emerging as the indisputable phenomenon. Increasingly, the imagined lofty selfish motivations on the part of a few scientists that divided the world in the past into blocks, are giving way to wider considerations of gains brought about by technological inventions whose products have unified the world and are in greater demand on the world market.

What then ought to be done to hasten the achievement of these noble ideals? CAPA would like this high-powered world conference to consider, inter-alia, the following propositions:

Technological Co-operation

There should be closer bilateral technological co-operation across international boundaries of the world to facilitate an increased mobility of scientists and technologists.

Collaborations

Every country, especially in the developing world, should establish a scheme for effective collaboration between the university and the polytechnic in all issues relating to technological inventions and innovations.

Women in Technology Education

Women should be encouraged to pursue technical education programmes because they will make the difference.

Technology Associations

Technologists must be accorded due recognition as "creators of wealth" for the world and should be encouraged and assisted to form professional associations under the auspices of the World Federation of Technology Organisation (WFTO) through which they could establish linkages with counterparts in other parts of the world.

International Technology Education Exchange

There should be created, under the auspices of the World Federation of Technology Organisations in Vancouver, an International Technology Education Exchange (ITEE) to accredit technology programmes, establish a data base of recognised accredited programmes and encourage transferability of professional credentials. ITEE would work in collaboration with UNESCO, technical education associations such as ACCC and CAPA, etc..

Conclusion

In conclusion, I wish to underscore, in no uncertain terms, CAPA's belief in the adage; "United we stand, divided we fall." Indeed this is real in the context of rapid technological changes in the world today. No one country or group of countries will prosper technologically unless they create and develop markets for their products world-wide.

Perhaps, ladies and gentlemen, in the context of the imperative need for a world-wide technological market, there is hope for excess funds from our big brothers to trickle down to us to give the dying polytechnic in Africa a new lease on life!

I acknowledge your indulgence. Ladies and gentlemen, thank you.

National Development and Technological Education—The Singapore Experience

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Introduction

The notion of "national development" carries with it the implications of valued and positive changes that bring about a better quality of life for the population as a whole. Concomitant with this notion are economic and social development. Thus, developments related to increasing the efficiency of the production system of a nation (whether it be processes, goods or services), meeting the basic needs and satisfaction of the population, reducing poverty, creating employment and creating equality of opportunities and increasing the welfare of all social groups are embraced within concept of national development.

National development is a multi-dimensional process that involves the economic, social and political systems of a nation. At this point, there is a divergence of views on the process to achieve the goals. This divergence hinges on the degree to which economic and social goals should be achieved through state planning and state intervention.

Based on the experience of East Asian countries, one may conclude that systematic and strategic planning at a macro-level is a pre-condition for successful and long term national development. This involves the setting of economic targets for various sectors, determining the availability of manpower, determination of skill sets and so on. Economic development has been a forced draft process, designed to drive pre-industrial economies into the modern age. Once that process is well under way, state planning and state intervention give way to a more entrepreneurial economic system.

In this scenario, human resources development is seen as a strategic tool in the context of national development. Training and education create from scratch the technological knowledge and skills base that is necessary to support the economic targets. This focus on education as a tool of national development is essentially a post World War II phenomenon.

For example, British historians have noted that in the early stage of industrialisation in England (1780–1850), education was never seen to be related to economic advancement because the level of knowledge and skills required for the early factories were about the same as that required for successful farming. Even the industrial revolution was not credited to education. In fact, British historians tell us that formal education was expanded to "reinforce factory discipline and teach respect for authority". Thus, the expansion of education in Britain was more to feed, rather than to drive, economic growth.

But more recent history tells a somewhat different story. After World War II, Japan embarked on a formal education programme with emphasis on education as the key to economic growth. The success of the Japanese example has brought about widespread conviction that there is a direct link between education and economic development. In fact, education in the case of developing nations, plays a critical role in inculcating in them essential work habits and discipline, equipping their people with basic literacy and fundamental skills as well as the foundation of technical knowledge.

The development of human resources is now widely accepted as a strategic tool for socio-economic development, particularly in promoting industrialisation and technological upgrading. This utilitarian view is particularly strong in developing countries which have a lower starting point in comparison with the developed countries.

It is, therefore, not surprising that education, in particular technological education, is one of the most important agenda items for developing nations today. East Asian nations like Singapore, South Korea and Taiwan which emulated Japan with their emphasis on education for economic growth and investment in specific forms of technology, appear to have reaped the benefits in national development. The experience of Singapore since self-government, which I am about to share, underlines this view.

This paper will share with you the Singapore education system and its historical context, with particular emphasis on how technological education supports manpower development.

The Singapore Education And Training System

Education has always played a vital role in Singapore's economic and national development, especially after self-government was attained in 1959 and full independence in 1965.

The early years just after self-government was achieved, were years of chronic unemployment, low educational levels, a demographic profile that showed the effects of the post-war baby boom, and communist labour agitation. The economic prerogative was therefore to create employment quickly. The strategy chosen was to attract multi-national corporations (MNCs) to Singapore to create jobs with low labour cost as compared with their home countries. This policy was, at that time, in marked contrast to the policy of economic self-reliance followed by most newly independent countries.

The consequential educational imperative was, therefore, the rapid expansion of primary and secondary education. Schools were rapidly built to standard designs and teacher training expanded. This served two purposes. The young population was kept in school and out of the influence of communist agitators and second, it enabled the Government to attract inward investments from MNCs to establish a strong manufacturing base. The emphasis was on quantity, rather than quality and on primary and secondary education, rather than tertiary.

There was another important imperative and this was to create in the multi-racial and multi-cultural population, a sense of national identity and commitment to Singapore as an independent nation. This continues to be true even to the present day.

The link between education and national development became closer as Singapore moved quickly into the next phase of economic development. Low wages went with low skills, and this was not sustainable in the long run, given the wage competition from other countries. The political leaders saw that to maintain a higher level of industry, the effective use and deployment of the limited human capital was essential. This meant that the education and training of the population needed to be ahead of industry demands, both in numbers and in type. Thus began the establishment of various agencies charged with mapping out the manpower needs of the country and to tailor the educational system to meet this need.

Prime among these agencies was the Council for Professional and Technical Education (CPTE), which was chaired by the Minister for Trade and Industry. Established in 1979, this Council sets targets for education and training at all levels. It institutionalises the link between trade and industry policy and the educational and training system, thereby ensuring that the human capital demands of new industries are met, by level, by number and by discipline. It de-aggregates the supply side of the equation into specific targets for universities, polytechnics, and the institutes of technical education. It also helps to highlight the required subjects for primary and secondary schools and junior colleges.

The CPTE's inputs for its manpower planning include the projected investment streams in various sectors, productivity growth, the projected GDP/GNP growth rate, changes in the demographic profile and labour pool and the matching of supply and demand sides of the manpower equation.

The CPTE's recommendations led to the rapid expansion of all levels of post-secondary education, from technical education at the skills level, polytechnics, and tertiary engineering education. This included the establishment of new institutions, as well as the expansion and upgrading of existing ones. The approval of the CPTE is often sufficient for government funds to be allocated for such an expansion by the Ministry of Finance.

The chief justification for this process of detailed manpower planning is that Singapore's population base is small and scarce and hence needs to be optimally deployed across various sectors. Left to themselves, students will make decisions with less than full information about long term investment goals and trends. This justification therefore places the long term economic and national policy goals ahead of the personal interest of the individual. Allocation of places in the various levels and courses of study are by merit and performance at landmark examinations, in a transparent process. In any case, almost the entire education system is government provided and this provides further justification for government intervention.

This system creates stresses and strains when individuals do not get into popular courses of study, particularly at University level, for example into law and medicine. Many Singapore students therefore go overseas to study, especially if they are not satisfied with their allocated place and if they can afford to. There is a political price that the Government has to pay for its policy.

However, personal interests are served in the end by the continued growth of the economy which is fuelled by the timely availability of skilled manpower in the various technical, professional and managerial sectors. The direct inward investment into Singapore is currently in the region of SGD 80 billion annually. The ability of the population to see and benefit from this, has enabled the government to maintain public support for this policy.

Technological Orientation of the Curriculum

The education system of Singapore is also characterised by a strong orientation towards science and technology, rather than the liberal arts. This is another manifestation of the utilitarian nature of educational planning.

The system has thus succeeded in producing a work force that can manage technology, primarily through three key features:

a) a bilingual policy with English as the language and the mother tongue as the second language
b) streaming of students into different ability classes
c) early incorporation of science and technology into the curriculum.

In the foundation years of primary schooling (Primary 1 to 4), one third of the curriculum time is devoted to the learning of English. Mathematics and science subjects are taught in English. As English is the language of science and technology, this policy has enabled Singapore to have a work force literate in English and competent to absorb new technologies quickly.

On the other hand, it should be noted that the emphasis of mother tongue in this bilingual policy ensures that our cultural and ethnic roots, as well as our Asian values, are not compromised or sacrificed in the rigorous pursuit of science and technology.

Secondly, streaming of students at Primary 4 (ten years old) and Secondary One (13 years old) according to academic ability has not only reduced the attrition rate but has also ensured that the potential in each child is maximised. At Primary level, slower learners will study their mother tongue at oral proficiency level so that more time could be devoted to the learning of English and mathematics. At secondary level, slower learners would take, as compulsory subjects, English, mathematics and computer applications, together with subjects with a technical-vocational bias. Such a system ensures that weaker students would have some technical skills to fall back on when they leave school.

Finally, to be prepared for life in a modern industrialised society, children must acquire the basic technical skills which will enable them to function effectively in a technological environment. As a result, on par with the study of English as the first language is the study of mathematics and science. Mathematics plays an important role in school curriculum from Primary One with 20% of curriculum time devoted to it. Science is part of the school curriculum from Primary Four. At Secondary level, less able students enter a five-year technical stream which will give them more application-based training in technical subjects.

The Special Role of Polytechnic Education in Singapore's Development

Special mention should be made of polytechnic education in Singapore, as polytechnics absorb 40% of each age cohort, after completing secondary education.

The polytechnics in Singapore provide a very intense work-related training and education leading to diplomas in specific career related areas. Students enter the polytechnics after their O-levels and study for three years. The polytechnics are unique in that they provide the highly very important middle-level support sector for business and industry. This has been a neglected area in many other systems where tertiary education almost always means degree level courses.

The four polytechnics, each sized for 12,000 students, have established a reputation for both innovation and strong industry relevance. 99% of their outputs are employed within three months of course completion. The four polytechnics collectively offer a diverse range of courses ranging from traditional engineering and information technology courses to non-traditional courses like nursing, tourism and hospitality, communication studies and design.

Adult Education

The rapid expansion of formal education according to the rate of economic development, has left a significant portion of the work force without appropriate qualifications. Many who where schooled in the early days of independence have only primary education, while those following have secondary education. Thus adult education for the working population to bring them up to date with modern technology and to keep them prepared for the rapid changes to come, is a key platform of the government. In this, it is working closely with the unions to ensure that members avail themselves of the opportunities being created.

The new growth industries require not only technical competence but also flexibility to develop new skills. A new apprenticeship scheme was launched in 1990, modelled on the German dual system. On-the-job or OJT training schemes have also been launched. The result has been skills deepening and broadening for many workers in the manufacturing sector.

Conclusion

The experience of Singapore illustrates how the driving force behind the education and training system, from school to university level, is not the needs of the individual, or even individual employers but that of the economy as a whole. While the emphasis is on encouraging individuals to participate in available courses and programmes, the objectives and standards are set according to what is seen as the needs of a future economy. In other words, the education and training system does not react to current needs but is planned to support future needs which are targeted by economic planners.

For the 1990s and beyond, our emphasis is for every child to be equipped with basic information technology skills so as to become independent learners. The use of computers as a teaching and learning tool within the classroom will be a fact of life and all schools and classrooms in Singapore will be equipped with computers. Computer literacy classes have become part-and-parcel of the curriculum such that pupils are often familiar with the latest developments in CD-ROMs, Internet and other multi-media systems.

The future, however, is less predictable and less capable of deterministic planning. The need for technical disciplines is balanced by problem-solvers who can work in multi-disciplinary environments on open-ended problems. This requires a shift to more information-synthesising skills from the current focus on content. Manpower planning will become more an art than a science and will be less exact than before. The challenge, therefore, for the Singapore education system is to respond to these challenges with creativity and innovation and to continue to anticipate the changes in economic structure that are inevitable.

However, what is certain is that the linkage between national development and education will not be diffused as the economy matures. What is more likely is that individual choice and private education will be factored in more into the equation.

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The National Labour Force: Self-Sufficiency and Development: Role of Technical Education and Vocational Training—The Experience of the Sultanate of Oman

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Introduction

Human Resource development (HRD) is a major component of socio-economic development and education is the backbone of HRD. Developed and developing countries alike, show great interest in maintaining a satisfactory level of education in general, and an improved level of technical education and that of vocational training in particular, in their societies. Experience shows that each country has its own plan and programmes to improve further the level of education and skills among its citizens. The common aim is to spread general education, technical education and vocational training and to enlarge its base, so as to diversify its output for the purpose of providing domestic labour markets with the volume and type of manpower needed to attain their developmental targets.

Similar interest has been witnessed in the Sultanate of Oman, as the country's experience with regard to HRD has been at the heart of the development strategy since the early 1970s. Special attention was given to education and special consideration was attached to the development of adequate technical education and vocational training systems and programmes. This was clearly reflected in the decisions made to reform the institutional framework of technical education and vocational training, its organisational structure and, above all, its system of education and training. All is achieved with the aim of attaining a diversified structure of technicians and skilled manpower that will satisfy the needs of domestic economic sectors for manpower, as well as achieve the country's target Omanisation.

Human Resource Development and the Development Strategy in the Sultanate

As experience has shown in the last 25 years, Oman's developmental strategy emphasised the importance of education, generally, and technical education and vocational training, in particular, as a mechanism that is aiming at increasing the Omani people's participation rate in economic activities.

The empirical evidence in this regard indicates the following:

The first Five-Year Development Plan (1976–1980) has witnessed the establishment of vocational training institutions and the enlargement of the vocational training base. During this plan, the Council of Education and

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Vocational Training was established, with policy formulation for education and vocational training as its major function. The linkages between education and training on one side, and labour market needs on the other, were also highlighted as one of the Council's main responsibilities.

The second Five-Year Development Plan (1981–1985) included a number of developmental projects aimed at upgrading the level of vocational training, improving its programmes and diversifying vocational training outputs so as to satisfy domestic needs for skilled and semi-skilled manpower.

This period has witnessed the establishment of the first Technical Industrial College in the Sultanate, known by that time as "Oman Technical Industrial College." The College was actually operated in the academic year 1984–1985. Since then, college graduates, with their technical as well as administrative specialisations and skills, filled many job vacancies in the domestic labour market.

To encourage the role of the private sector in the field of vocational training, certain measures were taken by the Government. Among these measures was the issuance of the Ministerial Decision No. 24/85, that was launched in March, 1985, for the purpose of allowing the establishment and facilitating the operation of private training institutes in the country. Based on that decision, an increasing number of private training institutes was given licence to start their actual operation of providing vocational training programmes to Omani nationals.

The development strategy for the nineties, as it was outlined in the plan document for (1991–1995), clearly indicated the Government's firm commitment towards the achievement of Human Resource Development in the Sultanate. Among the major objectives of the plan was the attainment of higher participation rates of Omani labourers among the various economic activities in the country. Accordingly, basic emphasis was directed towards achieving institutional reforms in the technical education and the vocational training sector, as well as developing its educational and training system. Some important decisions taken in this regard include the following:

1. The Royal Decree No. 31/91 regarding the formation of a Supreme Committee for Vocational Training and labour (SCVTL), and the Royal Decree No. 115/91 incorporating the establishment of a Vocational Training Authority (VTA). These constituted a firm step towards a new era for technical education and vocational training in the Sultanate.
2. The institutional reform of technical education, with the VTA decision to transfer four of its vocational training centres to become technical industrial colleges. This, added to Oman Technical Industrial College, takes the total number of the technical industrial colleges to five, (Muscat, Nizwa, Ibra, Salalah and El-Musanaah college). The newly established colleges began their operations in the academic year 1993–1994. Since then the total number of secondary education graduates who are enrolled in technical education has tripled.
3. The application of a modern system of technical education in the Technical Industrial Colleges, namely as: the General National Vocational Qualifications (GNVQ). This system was developed in Britain as an educational system parallel to that of Vocational and Academic Education Systems. It is important to mention that the GNVQ system

was adapted in such a way as to satisfy the Omani labour market requirements. The system was first applied as a pilot project at the Muscat Technical Industrial College in the academic year 1994–1995. This was followed by its application in the other four technical colleges (Nizwa, Ibra, Salalah, El-Musanaah) at the beginning of the academic year 1995–1996.

4. Developing the institutional framework of vocational training through the establishment of four vocational training centres as a substitute to the existing vocational training institutes. This institutional reform was followed by the introduction of a short course system. This system was first applied in the centres at the beginning of the academic year, 1994–1995, with the aim of providing the labour market with the required skilled and semi-skilled manpower in the automotive, carpentry, construction, electrical and mechanical occupations.
5. Giving permission in 1996 to the private training institutes to apply the British "National Vocational Qualifications" (NVQ) system for the purpose of providing the labour market with the type of skilled and semi-skilled manpower needed for employment in the private sector establishment.
6. Promoting the role of the private sector in vocational training. New regulations were issued to achieve that goal. These include the following:
    a) The regulation concerning the organisation of private training institutes, with the aim of achieving higher participation of the private sector in vocational training.
    b) The regulation on career development and on-the-job training, and the financial compensation procedures that were attached to it.
    c) The regulation on training according to the General National Vocational Qualifications and the National Vocational Qualifications.
    d) The decision concerning the development of the Omani Vocational Qualifications (OVQ) system to be applied in the Vocational Training Centres and the complying private sector institutes. The OVQ is expected to be in operation in 1999.

The future development vision of the Omani economy for the period 1996–2020 emphasised the importance of technical education and vocational training for human resource development in the Sultanate.

Labour Market, Employment and Omanisation Requirements

Based on the findings of the Population Census for 1993 and the statistical information issued by the Ministry of Development, it is indicated that the total number of the labour force that was working in the Omani economy by the end of 1993 had reached 667,100 persons. 35.7% of them were Omanis and 64.3% expatriates.

The Ministry of Development estimated that the total number of job opportunities in the Omani economy will increase from 667,100 in 1993 to reach nearly 1,288,600 job opportunities in the year 2020. The new vacancies that will appear in the national economy from 1993 to 2020 is expected to reach 619,900 vacancies, thus the new figure of manpower requirements is expected to reach an annual average of 23,019. This of course will be highly dependent upon the achievement of the economic growth hypotheses for the plan period 1996–2020.

Table1: Total Employment in the Omani Economy for 1993 and the estimated work force requirement up to the end of 2020

No.	*Occupational Categories*	*Total Employees in 1993 (Actual)*			*Estimated Total Work force Requirement in 2020*
		Omani	Non-Omani	Total	
1	Professionals	19,300	43,300	62,600	153,200
2	Technicians: TIC graduates	5,100	6,600	11,700	39,800
3	Other Technicians	10,500	11,800	21,300	51,300
4	Skilled Workers	110,300	47,200	157,500	453,600
5	Semi skilled workers	9,100	101,900	111,000	246,400
6	Limited skilled workers	84,100	218,900	303,000	344,300
	Total	**283,400**	**428,700**	**667,100**	**1,288,600**

Source: Ministry of Development: estimated total labour market needs in 2020

Based upon the above, estimated labour market demand for labour up to the year 2020, as indicated in table 1 it is estimated that the total supply of labour to satisfy the estimated demand of each occupational category on annual basis up to the year 2020, will be as follows:

Occupational Category	*Annual Labour Requirements up to the year 2020 to fill expected vacancies*
Professionals: (University Graduates)	3,356
Technicians: (TIC Graduates)	1,040
Skilled Workers	1,111
Semi-skilled Workers	10,967
Limited-skilled Workers	5,015
Total Annual Requirements	23,019

The supply should also be higher to allow for substitution of domestic labourers due to death, resignation, etc., as well as the total labourers required to replace non-Omanis as part of the Omanisation plan.

It is worth mentioning at this stage that Omanisation has high priority on the Government's agenda, as clearly reflected in the Ministerial Decision No. 127/94 that was issued by His Excellency the Minister of Social Affairs and Labour with the aim of increasing the level of Omanisation in private sector establishments. The decision targeted the percentage of Omani labourers in various economic sectors to reach the following by the end of 1996.

Table 2: Planned Omanisation by the End of 1996, per Economic Sector

Economic Sector	*Omanisation Target % of Total Employees*
Transportation, storage & communication	60.0
Finance, insurance and renal estate	45.0
Manufacturing	35.0
Restaurants and Hotels	30.0
Whole-sale and retail trade	20.0
Contracting	15.0

Source: Ministry of Social Affairs and Labour, 1994

It is expected at this stage, that the concerned authorities will submit reports to the Supreme Committee for Vocational Training and Labour which will indicate the achievements, and thus would help in formulating the necessary decision that should be made in the very near future to push forward the Government's drive towards higher participation of Oman citizens in various domestic economic activities.

In view of the findings of the Population and Housing census for 1993, with regard to labour market and employment status, and with consideration to the recent statistical information released by the Ministry of Social Affairs and Labour concerning the total number of non-Omani labourers working in the Omani economy by the end of 1995, the Omanisation policy with regard to private sector employment constitutes a basic element of the country's plan to achieve the human resource development target up to the year 2020.

To highlight the labour market and employment status in 1995, the report of the Ministry of Social Affairs and Labour indicated that there were 619,351 non-Omani workers in private sector employment. Their share in total employment shows their concentration in the following private sector activities:

31.6% in whole-sale and retail trades
25.8% in construction and contracting
14.7% in manufacturing
14.1% in social and community services

Table 3: Non-Omanis working in the private sector establishments by the end of 1995, distributed per economic activity

Economic Activity	*No. of Work Permits*	*Percentage (%)*
Agriculture and fisheries	18,934	3.1
Mining and Quarrying	5,128	0.8
Manufacturing	91,104	14.7
Gas, electricity and water	819	0.1
Construction	159,451	25.8
Wholesale and retail trade	195,250	31.6
Trade and Contracting	13,881	2.2
Restaurants and hotels	18,433	3.0
Transportation, storage and communications	6,435	1.0
Finance, insurance, real est. operation service	13,155	2.1
Social and community Services	87,487	14.1
Others	9,274	1.5
Total	**619,351**	**100.0**

Source: Ministry of Social Affairs and Labour, Annual Year Book 1995 Table No. 1 p. 101

Their distribution among major occupational categories is shown in table 4 which reveals the following indicators:

- Limited-skilled workers constituted 26.3% of the total non-Omani workers
- Production workers 15.2%
- Transport equipment operators 15%
- Service workers 14.6%
- Sales workers 13.7% of the total

Table 4: Non-Omanis working in the private sector establishment by the end of 1995, distributed per occupational category

Major occupational Categories	*No. of work permits*	*Percentage %*
Scientific and technical professions	24,774	4.0
Technical Professions	21,058	3.4
Directors, administrators and managers	9,910	1.6
Executives and clerical staff	15,484	2.5
Sales activities	84,851	13.7
Service activities	90,425	14.6
Agriculture and fisheries	22,916	3.7
Production labour	94,141	15.2
Transport equipment operators	92,903	15.0
Unclassified labour	162,889	26.3
Total	619,351	100.0

Source: ibid.

The above mentioned statistics gives clear indication about the future aspects of human resource development and the urgent need for manpower self-sufficiency in various domestic economic activities. This also highlights the importance of technical education and vocational training in providing the labour market with the technicians and skilled and semi-skilled workers that are required to satisfy domestic demand for labourers.

Technical Education Outputs and Omanisation

Since 1986, when the first group of technicians graduated from Muscat College and joined the labour market, technical education outputs became a major source of supply of technicians for all sectors of employment in the national economy. They provide technicians to the public, as well as the private sector establishments. The technicians' fields of specialisation include the following:

- Technical specialisations which include electronics, electricity, civil engineering, surveying, architectural engineering, mechanical engineering (production, automotive, and air conditioning), science laboratories (chemistry, biology and physics) and medical laboratories.
- Commerce and administration specialisations which include: computers, accounting, marketing, business administration, office management, insurance and executive secretariat.

Between 1986 and 1996, Muscat College supplied the Oman labour market with 2,971 technicians in various fields of specialisation. The technical education future outputs are going to increase as there is a rising number of secondary education graduates who are willing to join the technical education programmes provided at the industrial technical colleges. However, the admission capacity of the colleges is a limiting factor as their annual intake is around 1,500 students, 500 of them in Muscat college, and 25 in each of the other four Colleges at Al Musanah, Nizwa, Ibra and Salalah.

In pointing out the role of technical education output in achieving domestic self-sufficiency of technicians, the Ministry of Development estimates concerning the Omani labour market needs of technicians till the end of the year 2020 showed, as mentioned in Table 1, that the total need will reach 39,800 technicians, this will represent the total number of technicians (graduates of the Industrial Technical Colleges) that is expected to be employed in the domestic economy in the year 2020.

The supply of Technicians (graduates of TIC) up to the year 2020 is required to satisfy the following:

- To fill new vacancies in the labour market.
- To substitute for all non-Omani technicians working in the labour market.
- To substitute for Omani technicians who are expected to die, retire, etc..

With these requirements in mind, Table 5 below shows the following needs up to the year 2020:

The total number of technicians that is required to fill new vacancies to be created in the labour market due to economic growth is 28,100 technicians.

6,600 technicians are required to substitute non-Omani technicians: this figure represents those who were actually working by the end of 1993.

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1,275 technicians for the substitution of Omani technicians who were working in 1993.

Accordingly, the total supply requirements throughout the period 1993–2020 is expected to reach 35,975 technicians. This clearly indicates that the Industrial Technical Colleges should supply the labour market with 1,322 technicians annually. This will match the supply of technicians with the demand in the Omani labour market, a situation that will lead to a self-sufficiency status with regard to technicians expected to be working in domestic labour market by the end of the year 2020, when full Omanisation of technical jobs will prevail.

Table 5: Total supply of technicians in the year 1993, and the total technician requirements in 2020 (Graduates of technical industrial colleges only)

Category	*No. of Technicians*
*In the year 1993	
Omani Technicians	5,100
Non-Omani Technicians	6,600
Total supply	11,700
*In the year 2020	
New vacancies for Technicians (due to economic growth)	28,100
100% substitution of non-Omani Technicians who were on the job in 1993	6,600
Substitution of Omani Technicians (due to death, retirement, etc. 25% of their total in 1993)	1,275
Total Demand	35,975
Annual demand for the period 1993–2020 = 35,975/27 years = 1,332 Technicians	

Source: Calculated on the basis of information released by the Ministry of Development Population Census Finding for 1993, and the Omani Economy Manpower Requirements up to the year 2020.

Achieving this target of self-sufficiency in technicians is highly possible as the five Industrial Colleges now operative in the Sultanate have a total intake of 1,500 students annually. This clearly indicates that the technical education programme leavers and drop-outs should not exceed an annual rate of 11.2% of the total students enrolled in technical education between 1993 and 2020.

Vocational Training Outputs and Omanisation

Estimates published by the Ministry of Development with regard to the Omani economy needs of the vocational training outputs indicated that the total requirements for skilled and semi-skilled labourers by the end of 2020 will reach about 453,600 and 246,400 labourers respectively. The new vacancies expected to be created in the national economy throughout the period 1993–2020 are estimated at about:

- 296,100 new vacancies for skilled workers

- 135,400 new vacancies for semi-skilled workers

Based upon these estimates, the supply of skilled and semi-skilled workers should be adequate to meet the total demand expected to prevail in the domestic labour market. Table 6 shows clearly the projected demand for skilled and semi-skilled workers in the Omani economy by the year 2020, and reflects the total amount of supply of skilled and semi-skilled workers required by then if self-sufficiency of skilled and semi-skilled workers in the Omani labour market is to be attained.

Table 6: The total supply of skilled and semi-skilled workers in 1993 and the total estimated requirements of skilled and semi-skilled workers in 2020

Category	*Skilled Workers (No.)*	*Semi-skilled Workers (No.)*
* In the year 1993		
Omani Workers	110,300	9,100
Non-Omani Workers	47,200	101,900
Total Supply	157,500	111,000
*In the year 2020		
New Vacancies (due to economic growth)	296,100	135,400
100% substitution of non-Omani workers who were on the job in 1993	47,200	101,900
Substitution of Omani workers (due to death, retirement, etc., 25% of their total in 1993	27,575	2,275
Total requirements	370,875	239,575
Annual supply needed to attain self-sufficiency by the year 2020	13,737	8,874

Source: see table 5

Table 6 gives a clear indication with regard to the total supply of skilled and semi-skilled workers that should be made available throughout the period 1993–2020. If self-sufficiency and 100% Omanisation of skilled and semi-skilled workers in the Omani economy is to be achieved, then the total annual supply of skilled and semi-skilled workers throughout the period up to the year 2020 should reach 13,737 and 9,874 skilled and semi-skilled workers, respectively. The success of self-sufficiency and the achievement of the Omanisation target is of course tightly related to the ability of vocational training institutions for Omani youths to be enrolled in vocational training programmes and their willingness to join in private sector employment on the other.

However, the development plan emphasised that the above target can be achieved through mutual co-operation and adequate partnership in the provision of vocational training between the government and the private sector vocational training institutions. The plan highlighted the role of institutions in both sectors in this regard as follows:

- The VTA Vocational Training Centres (VTC) should provide the labour market annually with 720 skilled workers and 1,000 semi-skilled workers.
- Private Training Institutions should provide the labour market with 13,017 skilled workers and 7,874 semi-skilled workers, throughout the period to the year 2020.

Cost of Training Compensation and Omanisation in the Private Sector

The empirical evidence with regard to Omanisation shows a noticeable achievement in the government sector. This can be clearly judged as the level of Omanisation in that sector of employment increased from 58.8% in 1985 to nearly 70% by the end of 1996.

Oman's employment policy at this stage of economic growth and development has a major target of higher participation of Omani youths into private sector employment. To achieve this target, the development plan for the period 1991–1995, and the futuristic developmental vision for the period 1996–2020 witnessed an active drive towards the achievement of higher Omanisation level in various sectors of private employment. Decisions taken by the government in this regard aim at the following:

- Setting guidelines for Omanisation through fixing a certain percentage level of Omanisation to be achieved in a fixed period of time in each defined economic sector as mentioned earlier in Table 2.

To achieve that, an action plan was issued by the concerned governmental authorities that created a link between the issuance of non-Omani work permits for a certain private sector establishment and its response to the Omanisation plan.

- Compensation for the cost of training and promulgation of regulations that aim at the encouragement of Omani youths towards joining the vocational training programmes, and to encourage private establishments to employ Omanis and to train them vocationally up to the level that will make it possible for them to replace non-Oman workers in their establishments.

Decisions taken by the Supreme Committee for Vocational Training and Labour include the promulgation of the following regulations aimed at regulating the cost of training compensation that should be paid to the private establishments:

- The Regulation on Career Development and On-The-Job Training, which was in practical application throughout the period from October 1, 1991, until May 31, 1996. It achieved the following:

Providing vocational training for 4,347 nationals, 3,209 males and 1,138 females. The government agreed to bear the full cost of their training and a proportional part of their monthly salaries.

627 establishments and private companies benefited from the financial compensation scheme included in this regulation. Contracts of employment for the purpose of achieving Omanisation was a pre-condition for financial compensation to the concerned establishments and companies.

The total number of trainees distributed among various occupational areas was as follows: 58.7% in administration and related occupations; 31.5% in technical occupations, and 9.8% in handicrafts.

The total financial compensation earmarked for training in accordance with this regulation reached about R.O. 14 million, including the cost of training, and the trainees' salaries and allowances according to terms and percentages defined in the regulation.

Table 7: Number of private companies and establishments that benefited from the regulations and total number of trainees distributed among various economic sectors 1/10/91-31/5\96

Economic Activity	*No. of Establishments*	*Trainees*	
		No.	*%*
Agriculture and fisheries	2	6	0.1
Mining and quarrying	7	28	0.6
Manufacturing	108	865	20.0
Electricity, gas and water	26	208	4.8
Construction	48	132	3.0
Trade, car repairs and home appliances	198	1,392	32.0
Restaurants and hotels maintenance	14	208	4.8
Transportation, storage and communication	47	305	7.0
Banking and insurance	35	644	14.8
Real estate and Commercial projects	56	193	4.4
Education and training	23	143	3.3
Healthy and social work	9	16	0.4
Community service	54	207	4.8
Total	627	4,347	100.0

Source: Vocational training authority. General Directorate for vocational training, private institutes department.

To evaluate the impact of the application of this regulation upon the issue of Omanisation and the employment of national labour in the private sector, a survey was recently constructed by the General Directorate of Planning and Development at the VTA, which covered 10% of the 90 private companies and establishments which fulfilled their training programmes and got compensated financially for the cost of training in accordance with this regulation. The initial findings of that survey indicated the following:

- By the end of 1991, the total number of employees at the companies surveyed was 6,956 persons; 35% of them were Omanis and 65% non-Omanis.
- By the end of October, 1996, the total number of employees at the companies surveyed was 10,552 persons. 38.8% were Omanis, 61.2% were non-Omanis.

Thus, Omanisation percentages in the surveyed companies and establishments has increased from 35% in 1991 to 38% in 1996.

In addition to the increase in Omanisation, the financial compensation for the cost of training achieved the following:

- Providing opportunities for the private sector establishments to employ and to provide vocational training for national workers, and thus giving them a real chance to replace non-Omani workers.
- Up-grading local workers' skills that yielded an increase in their productivity rate.
- Improving the technical and practical abilities of the newly employed workers, and helping to increase their efficiency in dealing with production technology.

A new regulation was issued as a substitute to the 1991 regulation; the new Regulation on Training, according to the General National Vocational Qualifications and National Vocational Qualifications, became applicable by the beginning of June, 1996. Its major aim is to increase and to activate further the role of the private sector in the field of vocational training and technical education. Its ultimate target is to increase the level of Omanisation in the private sector employment and to pave the way for new graduates and new entrants to the labour market to get the training required to facilitate their enrolment in domestic employment.

Based upon this newly launched regulation, the VTA planned to train 5,000 citizens throughout the period 1/6–31/12/1996, with a total cost of about R.O. 7 million. It is also expected that the training plan for 1997 will include the training of 10,000 citizens, with a total estimated cost of about R.O. 14 million. All with the aim of achieving a higher rate of Omanisation in various economic sectors of employment.

Conclusion

Human Resource Development is one of the basic elements of the Sultanate's development strategy. Experience shows that technical education and vocational training in the Sultanate was subject to organisational development, as well as educational institutional reform for the purpose of diversifying the status of manpower supply to meet domestic manpower requirements on the one hand, and to minimise dependence upon expatriate workers in domestic economic activities on the other.

In spite of the Omanisation target achieved in both the public and the private sector of employment, the futuristic vision for the Omani economy and the developmental plans associated with it up to the year 2020 pay great emphasis on developing human resources generally, and technical education and vocational training in particular. The ultimate goal is, of course, to achieve an acceptable level of self-sufficiency of technical and skilled manpower, and to attain a higher rate of Omanisation in the private sector employment comparable to that achieved by the government sector.

Policies and decisions directed towards the attainment of trained and skilled national manpower, and the availability of the financial requirements to enhance the status of technical education and vocational training in the Sultanate will facilitate the achievement of self-sufficiency in the field of manpower, and will facilitate and increase the participation rate of the national manpower in domestic economic activities.

Recommendations

Based upon the experience gained by the Sultanate in developing technical education and vocational training, and bearing in mind its vital role in manpower self-sufficiency, the following recommendations are of particular importance:

- Further development of technical education and vocational training with the aim of diversifying its output is required if such output is to meet future development requirements. This is important as sustainable development largely depends upon the availability of resources generally, and qualified manpower in particular.
- Building upon a national cadre of technicians and skilled manpower with the ultimate goal of achieving self-reliance upon national manpower requires adequate and active co-operation between the government and the private sector. It also requires an active and well-defined employment policy that takes into consideration the achievement of better working conditions that will help to achieve the required level of Omanisation in various sectors of employment.
- Emphasis should be directed towards the achievement of quality manpower. This should be the major aim of technical education and vocational training programmes. Quality manpower would yield higher productivity and better work standards.

To conclude, there is a need for empirical studies with regard to labour market and employment status and conditions in the Omani labour market. The findings of such studies will be of particular importance for policy makers to achieve the national strategy aim for human resource development. It will help the process of self-sufficiency of manpower and will guide us towards a better future.

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IIT Bombay—The Growth of an Institute for Higher Technological Education

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Introduction

The Indian Institutes of Technology owe their existence to the vision of Pandit Jawaharlal Nehru, who mooted the idea of establishing them to provide trained technical personnel of international class who would act as leaders in technology for the newly born independent India. The Institutes were set up based on the recommendations of a high power committee of the Government of India called the Sarkar Committee. The Committee had recommended that four higher institutes of technology of the level of their counterparts in Europe and the United States be established to set the direction for the development of higher technical education in India. The institutions were to be designed with the necessary dynamism, flexibility of organisation and capacity to adapt in the light of expanding knowledge and changes in the socio-economic requirements of modern society. While accepting the recommendations of the Committee, the Government of India realised that establishing the institutes with its own resources would take a long time. Hence, it decided to seek international co-operation and exchange of experience from developed countries which would be of immense value in establishing the institutes expeditiously.

Birth of IIT Bombay and its Growth

The first IIT was established at Kharagpur in the eastern zone in 1951. The second institute[+] was established in Bombay in 1958 after obtaining necessary assistance from UNESCO with funds contributed by the Soviet Union. Many discussions were held at Moscow, Paris and New Delhi before final agreement was reached between the Government of India and UNESCO. UNESCO agreed to provide equipment and technical experts mainly from the Soviet Union, while the Government of India accepted the responsibility for all other expenses including the cost of the building project and recurring expenses.

An Institute is not just a collection of buildings and other physical facilities. It is really the faculty, students and the tradition that is built over the years. There could be a time-bound programme to create infrastructure facilities, but there is not one to try to build good and healthy traditions. Pandit Nehru rightly said that "While it is relatively easy to put up a factory or a plant or a project, it

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[+] Three more IITs were established in the early sixties in Delhi, Kanpur and Madras making a total of five. A sixth IIT has been started very recently in 1995 in the north east in Guwahati, Assam.

is much more difficult and it takes much more time to train the human beings that will run a factory or put up another factory or plant."

In December, 1956, the first team of UNESCO experts arrived, headed by Professor V. S. Martinovsky, Director of the Technological Institute of the Food and Refrigeration Industry at Odessa. They stayed for two years. With Professor Martinovsky came experts in machine-tool building, fuel technology and the technology of iron and steel. They were joined in the next few months by other experts covering a very wide range of subjects.

The first task was to study the practical problems connected with the establishment of a new institute. The team set about familiarising itself with Indian conditions by visiting the IIT at Kharagpur, the Indian Institute of Science at Bangalore and the Department of Chemical Technology of the University of Bombay. After eight months, the team met in Mumbai along with the Planning Officer of the Institute, Dr. P. K. Kelkar, to pool the knowledge gained.

The site chosen for the Institute was at Powai, eighteen miles from the city. It had an area of 550 acres and was given by the then Bombay State Government. While construction was being started, the first academic session of the Institute opened on July 25, 1958, in its temporary home at the Silk and Art Silk Mills Research Association building in Worli (Bombay) with 100 students. These students were selected from over 3,400 applicants for admission to the first year undergraduate programmes in Chemical, Civil, Electrical, Mechanical and Metallurgical Engineering. Towards the end of that year, ten UNESCO experts, eight from the Soviet Union and one each from USA and Yugoslavia were working mainly for development of new post-graduate study programmes, the undergraduate study programmes being entirely handled by the Indian teaching staff already appointed. In fact, two postgraduate programmes leading to the Master's degree in Electro-Vacuum Technology and in Industrial Electronics were introduced in the latter part of 1958 with four students for each programme. Thus, one of the main objectives of establishing the Institute, which was to develop facilities for studies in a variety of specialised engineering and technological sciences was given concrete shape in the very first year of its existence. All through the subsequent period of development, the need for establishing adequate facilities for postgraduate studies and research was kept uppermost in mind. The first Director of the Institute, Prof. S. K. Bose, was appointed in November, 1958.

While the Institute was functioning provisionally at Worli, a determined effort was made to expedite the progress of the building project at its permanent location. When Pandit Jawaharlal Nehru laid the foundation stone of the Institute at Powai on March 10, 1959, water and electric supply lines were just being laid and one approach road to the site was under construction.

The first phase of the building programme at Powai included the construction of the main building, several departmental buildings, workshops, heavy laboratories, pilot-plant installation buildings, installation of water, electricity and sanitary services for the campus, residential quarters for teaching staff members numbering 350, hostel accommodation for over 2,000 students, quarters for administrative and ancillary staff numbering about 700 as well as all the other amenities that a modern academic community requires.

During the period between July, 1959, and March, 1960, one half of the Institute was functioning at Worli concerned with the activities of students admitted in 1958, while the other half of the students representing fresh undergraduate intake was working at Powai. Most of the staff members were scattered all over the city. It was indeed a difficult period with the Institute functioning partly at Worli and partly at Powai.

The Institute had to face the challenge of matching UNESCO's assistance programme with its own developmental achievements so that the assistance given could be fully utilised. It meant an all-out effort on an intensified building construction programme, recruitment of Indian staff members and provision of other facilities for the development of academic activities.

The first UNESCO assistance programme could meet two-thirds of the total requirement of non-indigenous equipment required for the Institute. A separate bilateral agreement entered into by the Governments of India and the USSR in December 1958 was helpful, but was not adequate for meeting the balance of the requirement of equipment for all the ninety-eight laboratories planned to be set up at the Institute. A further request for assistance was made on the recommendations of UNESCO experts who had worked in the Institute over the first three years. It is no exaggeration to say that this assistance was given to the Institute in 1961, because of its achievements in the proper utilisation of the first assistance programme. This additional assistance helped the Institute to make up deficiencies in the requirement of equipment for the various laboratories as well as to get an extension of the services of experts.

The third academic session commenced in July, 1960, with an enlarged intake of 296 undergraduates in five branches of engineering and 76 students for the Master of Technology degree programme in 16 different specialisations. By September, 1962, all the departmental buildings were ready and the laboratories and classrooms were in the process of being set up at their permanent places.

The first convocation of the Institute was held on December 22, 1963. Dr. S. Radhakrishnan, the then President of the Republic of India and Visitor of the Institute was the Chief Guest. Dr. Radhakrishnan said that the Institute was an example of the growing inter-dependence among nations. He remarked that technologists, scientists, engineers and others, all were working for a 'Republic of Science'—a world of free communication in which humanity lived as one family.

The years 1962 to 1965 ushered in a period when an expansion of student intake took place. Although initially planned for an intake of 200 postgraduate students and 320 undergraduate students, the undergraduate admission capacity had to be increased from the academic session commencing in July, 1963, because of the enlarged requirement of technical manpower. The intake in postgraduate programmes was also gradually increased during the period. A notable development during this period was the beginning of the doctoral programme. One student was admitted to a programme of doctoral study in 1962 in Metallurgical Engineering. By the end of 1966, the Institute had 135 Ph.D. candidates registered for work in engineering and sciences. Along with the growth of activities in engineering, there was a corresponding increase in similar activities in science as well. The response for the Master's degree programmes in Physics and Applied Geology, started in 1964, was a gratifying experience.

During this period, necessary plans were made to offer M.Sc. programmes in Chemistry and Mathematics.

This period of development showed a gradual expansion of student strength and an attempt at consolidating the undergraduate programmes based on the experience gained. It also gave an indication of the direction for further growth. It was the general opinion at the end of this period, that the Institute's capacity for expansion should mainly be utilised in the direction of postgraduate activities including the establishment of centres or schools of advanced studies and research in certain specified fields.

In January, 1965, Mr. Rene Maheu, Director-General of UNESCO, visited the Institute. He was pleased to see the project in its completion stage. His visit is commemorated by a bronze plaque fixed at the main entrance of the Main Building with the inscription: "UNESCO assistance to the Indian Institute of Technology, Bombay stands unique as the first venture of generous assistance in establishing an advanced centre of learning and research. In commemoration of the assistance given, this plaque was unveiled by Mr. Rene Maheu, Director General, UNESCO, on 30 January, 1965."

The ten-year UNESCO project was completed in 1966. It marked a milestone in the educational history of India. In a fitting ceremony in Bombay on 4 December, 1966, the achievements were highlighted by the Director-General of UNESCO, who described the event as the coming-of-age of the Institute.

As stated earlier, the assistance that the UNESCO experts provided to the Institute came mainly from the USSR. A few experts also came from USA, Yugoslavia, Federal Republic of Germany and Czechoslovakia. In all, 59 experts came for periods ranging from about 1-3 years. In addition, 12 technicians came specifically for installing some of the equipment and commissioning some of the instruments. UNESCO assistance also provided a large amount of equipment and a number of fellowships for higher studies, research and training in the USSR. 25 faculty members of the Institute benefited from these fellowships by studying in the USSR.

IIT Bombay Today

Today, 30 years later, it would be fair to say that IIT Bombay has fulfilled the aspirations with which it was set up and has contributed significantly to the growth of the techno-economic strength of the country in a number of ways. It has produced high quality engineers and scientists and continues to do so. In terms of numbers, the account is as follows:

- 8,000 B. Tech. students have passed out in various branches of engineering and technology.
- 6,000 M. Tech. students have passed out in various branches of engineering and technology and in a number of interdisciplinary areas.
- 250 students have obtained the degree of Master of Design (M. Des.) in a unique programme specialising in Industrial Design and Visual Communication.
- 1,200 MSc. students have passed in different science streams.

- 500 officers from defence and other government departments have obtained the postgraduate diploma (DIIT) in specialised fields like Computer Science, and Dock and Harbour Engineering.
- 1,500 PhD students have successfully completed their research work in various areas of engineering, technology, science, humanities and social sciences.

Today alumni of IIT Bombay are doing very well in various capacities as Entrepreneurs, Managers, Technocrats, Consultants and Advisers and as Faculty, both in India and abroad. At home, they are contributing to the growth of the techno-economic strength of the country and also as entrepreneurs, generating employment. Abroad, our alumni have enhanced the prestige of the Institute and the country by their excellent performance in whatever career they have chosen.

Organisation

The Indian Institute of Technology, Bombay, together with the other five IITs in the country, was established under the Institutes of Technology Act, 1961. The President of India is the Visitor of the Institute and there is an apex body known as 'The Council of the IITs' with the Minister, Human Resources Development, in the Central Government as the Chairman. The Council includes the Chairmen of the Boards of Governors and the Directors of all the IITs. It concerns itself primarily with laying down broad guidelines on matters of policy.

At the institutional level, IIT Bombay is governed by a Board of Governors with a Chairman nominated by the Visitor, the Director as a member and the Registrar as secretary. Besides this, there are four persons having specialised knowledge or practical experience in respect of education, engineering or science nominated by the Council. Two professors are nominated by the Senate. Additionally, one technologist or industrialist of repute is nominated by the Government of each of the States of Maharashtra, Madhya Pradesh and Gujarat.

For all academic matters, the Senate is the authority having control and responsibility for the maintenance of standards of instruction, education and examinations and all other allied academic matters. The Senate is mainly constituted of all the professors of the Institute and the Director is the Chairman.

The key people in the execution of the Institute's activities are the Director and Deputy Director who are assisted by Dean (Research and Development), Dean (Planning), Dean (Students Affairs), Dean (Academic Programmes) and Dean (Resources Development), and the Heads of the Departments, Centres and Schools. The Administration is managed by the Registrar, with senior administrative officers being assigned for specific areas such as Estate Management, Materials Management, Personnel Management, Finance and Accounts, and Academic Affairs.

The organisational structure consists of departments, centres and schools. The present structure is as follows:

Departments	Centres/Schools
Aerospace Engineering	Advanced Centre for Research in Electronics
Chemical Engineering	Centre for Studies in Resources

Chemistry

CivilEngineering

Computer Science and Engineering

Earth Science

ElectricalEngineering

Humanities and Social Sciences

Mathematics

MechanicalEngineering

Metallurgical Engg. and Materials Science

Physics

Engineering

Centre for Technology Alternatives for Rural Areas

Computer Aided Design Centre

Computer Centre

Environmental Science and Engineering

Industrial Design Centre

Regional Sophisticated Instrumentation Centre

School of Management

Apart from the Departments, Centres and Schools, there are interdisciplinary groups in the areas of Biomedical Engineering, Biotechnology, Corrosion Science and Engineering, Energy Systems Engineering, Industrial Engineering and Operations Research, Reliability Engineering, Systems and Control Engineering

Academic Programmes

The programmes and courses offered at IIT Bombay have the flexibility to evolve and change, and to respond to new challenges. The Institute conducts educational programmes leading to the degree of Bachelor of Technology (B. Tech.), Master of Science (MSc.), Master of Technology (MTech.), Master of Design (MDes.), Master of Management (MMgmt.), Master of Philosophy (MPhil.) and Doctor of Philosophy (PhD.) in the following areas:

B. Tech.

Aerospace Engineering, Chemical Engineering, Civil Engineering, Computer Science and Engineering, Electrical Engineering, Engineering Physics, Mechanical Engineering, Metallurgical Engineering and Materials Science.

MSc.

Biotechnology, Chemistry, Physics, Earth Sciences, Mathematics

M Des.

Industrial Design, Visual Communication

MPhil.

Planning and Development

M Tech.

Aerospace Engineering, Chemical Engineering, Civil Engineering, Computer Science and Engineering, Electrical Engineering, Earth Sciences (Geoexploration), Mechanical Engineering, Metallurgical Engineering and Materials Science.

Biomedical Engineering, Corrosion Science and Engineering, Energy Systems Engineering, Environmental Science and Engineering, Industrial Engineering and Operations Research, Reliability Engineering, Systems and Control Engineering.

M Mgmt.

Technology Management, Manufacturing Management

PhD.

All engineering disciplines, interdisciplinary areas, science disciplines and the humanities and social sciences.

The Institute also offers, from time to time, specialised programmes leading to a postgraduate diploma (DIIT).

Admission to the IIT Bombay undergraduate programmes is offered to those qualifying through the prestigious Joint Entrance Examination conducted all over India every year by the IITs. About 100,000 students appear for this examination held in the first week of May and only about 2,000 qualify for admission. Students abroad are offered admission based on the academic performance in their schools and their SAT scores. The Graduate Aptitude Test in Engineering (GATE) and Common Entrance Examination for Design (CEED) are two qualifying examinations for admission to the M. Tech. and M. Des. programmes. Departmental tests are conducted for admission to the other programmes.

The teaching programmes are characterised by their flexibility and informality. Courses are continuously updated and new courses, especially electives, introduced in response to recent developments. The faculty strength is about 400 and a student faculty ratio of 8:1 is maintained. There is a strong faculty-student interaction and students have opportunities to work on seminars and projects under the faculty's guidance. Many of the projects are sponsored by industry and government agencies and provide both students and faculty a chance to tackle live problems.

Students get initiated into research activity at the undergraduate level when they work on a thesis project in the final year. At the postgraduate level, design, fabrication and submission of a dissertation of the work forms an integral part of the MTech. programme. At the doctoral level, students undertake full fledged research work in wide ranging areas, in applied as well as fundamental aspects of science and technology. Research work done by project staff serves the dual purpose of completion of important projects for sponsoring agencies as well as acquisition of a doctoral degree.

Every year about 800 students obtain their degrees from IIT Bombay. Of these approximately 300 students obtain BTech/MSc. degrees, while the remainder obtain the degrees of MTech/MDes./MPhil./MMgmt. and PhD.. A majority join the private sector and a significant number have their own business or work in educational/research institutions. Thus, IIT contributes substantially to the manpower requirements in the industrial development of the country.

Change is a necessary feature of a modern and dynamic university. It may be worthwhile therefore to describe some of the new academic programmes of the Institute.

The School of Management has been recently formed. It began to offer a unique two-year Master of Management programme from July, 1995. The programme fulfils a long standing need to provide managers with adequate exposure to technology development and manufacturing management. The School will also conduct short and long term Executive and Management Development Programmes.

From July, 1995, Department of Mathematics of the Institute has offered a new Master of Science programme in Informatics and Applied Statistics. The programme is expected to meet the growing need for people trained in Information Science and Technology.

From July, 1996, the Institute has offered a five-year BTech-MTech. dual degree programme for students who qualify through the Joint Entrance Examination. Admissions have been made in the disciplines of Chemical Engineering, Electrical Engineering and Mechanical Engineering. The curriculum includes most of the course work required for the BTech. programme, selected courses in the area of specialisation of the MTech. programme and an intensive MTech. thesis project spread over a period of one year. The specialisations offered are in contemporary areas of modern technology. At the end of five years, the students will be awarded a BTech. degree in the particular engineering discipline and an MTech. degree in the specialisation. It is believed that this unique innovative programme will attract much attention in the years to come.

In addition to the above academic programmes, the Institute organises a large number of short intensive courses in specialised topics both for practising engineers and for teachers from engineering colleges under the Continuing Education Programme. Some of these courses are conducted at the Institute, while some are conducted 'in-house' at the specific request of industries.

IIT Bombay also offers training to teachers from other institutions on a regular basis under the Quality Improvement Programme. The faculty members selected under the programme usually work for a Master's or a PhD. degree.

Research and Development Activities

IIT Bombay has made concerted efforts to put itself in the mainstream of national development through sponsored research and consultancy. Many faculty members undertake sponsored research and consultancy projects. Faculty undertake sponsored research projects in thrust areas in science and engineering funded by various national agencies like the Department of Science and Technology, Department of Electronics, Department of Space, Aeronautical Development Agency, Department of Atomic Energy, Oil and Natural Gas Commission, etc.. Many are also working on missions of national importance. A few projects are also being funded by international agencies. Typically in one year, there are about 400 on-going sponsored projects. The sponsored research has ushered in intense research activity leading to the formation of active research groups and has helped in the creation of modern research facilities in key areas.

Consultancy has been a major avenue of interaction between faculty and industry. Consultancy work provides an opportunity to tackle live industrial problems and enhance professional expertise. There are collaborative and consultancy projects with many industries, some abroad. About 700 to 800 projects are executed every year.

The office of the Dean (R and D) provides the necessary liaison with industry and sponsoring agencies. The office helps industry to identify faculty expertise and institutional facilities, and assists faculty in identifying industry problems.

The Departments and Centres have well equipped research labs and workshop facilities. Besides, there are a number of central facilities such as the Central Library, Central Workshop, Printing Press, etc. Many new research facilities have been acquired or developed in the last few years. Perhaps the most important is the Computer Centre which started functioning in 1986 with facilities which have been continuously updated. The Computer Aided Design Centre with its own mini computers and work stations, supplemented by additional computing facilities, caters to CAD activity in Chemical Engineering and Metallurgical Engineering. Research groups like VLSI Design, CAD/CAM also have computing facilities which are accessible to other departments for development activities. Important experimental facilities set up by various departments include laboratories for robotics, biotechnology, microelectronics, microprocessor applications, telematics, remote sensing, low temperature physics and aerodynamics.

The Institute has a Regional Sophisticated Instrumentation Centre set up with the assistance of the Department of Science and Technology to provide sophisticated analytical facilities not only to the Institute but also to industry and research organisations.

IIT Bombay has an excellent library containing up-to-date reference material in science and technology. The collection comprises over 200,000 books, 60,000 back volumes of periodicals, besides current journals, standards, reports etc. totalling over 300,000. A new extension has been added to the library recently to house the growing number of books and journals, and the library systems have been computerised.

Project staff are appointed to assist in the research projects. IIT Bombay also has technical staff numbering over 900, to maintain the laboratories and workshops.

Faculty

The Institute is fortunate in having very well qualified faculty, almost all of whom possess doctoral degrees. Indeed, faculty provide the real strength to the quality of the Institute's programmes. The faculty of IIT Bombay are involved in a varied range of activities which reach out much beyond their teaching and research commitments. Valuable contributions of time and expertise are made towards IIT's academic and developmental activities by serving on committees relating to evaluation, admission, curriculum development, scholarships, as well as campus planning, accommodation, security, etc..

IIT faculty members have the distinction of being invited to serve on national and state level committees on science and technology, on editorial boards and as reviewers for leading professional journals and publications and on selection committees and review boards of leading institutions and governmental agencies.

Actively involved in the Institute's extension activities such as continuing education, workshops and conferences, faculty members individually and as interdisciplinary teams, are also the backbone of the research programmes of the Institute. Research papers written by the faculty find a place in prestigious national and international journals. The faculty have also published a number of books and contributed chapters to books.

Another praiseworthy activity of many of the Institute faculty is their involvement in the development and production of new teaching materials, which range from text books to software, computer-based instructional material to instructional videos.

The Campus

IIT Bombay is a small township in itself. Consciously developed, the campus has retained and increased its greenery, becoming rich in natural flora and fauna over the years.

The campus is connected to the city proper, through buses and local trains. However, most facilities are available on campus itself. These include two banks, a shopping centre, two schools for children, and a well equipped hospital. All students and most of the faculty live on the campus. The peaceful atmosphere of the campus belies the full range of activities going on to complement the academic life. Student activities are organised through the Students Gymkhana and are held primarily at the Students Activities Centre. There are excellent facilities for sports, including a swimming pool, tennis, badminton and squash courts, and vast playgrounds for field games. Wildlife camps and trekking are popular off-campus activities at IIT Bombay. The facilities for sports are matched by the cultural activities on campus. There are cultural and social clubs, film clubs, classical music societies, debating and drama clubs and a hobbies club.

Concluding Remarks

Today, IIT Bombay stands out as a shining example of what can be achieved with projects of international co-operation if they are carefully planned and executed in the early years and if they continue to receive the right kind of support. In the 50th year of our country's independence, it is a pleasure for us to extend warm greetings to sister institutes across the world and to offer our help in the task of setting up such institutes in other countries. This offer is made as a joint one on behalf of the five established IITs. We believe we are now well equipped in terms of human resources and experience to make such an offer and that we would be furthering the cause of international co-operation in doing so.

Cultural Diversity in a Tertiary Institution: Threat or Opportunity?

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Synopsis

Following the renunciation of the previous Government's policy of racial segregation by the new South African Government, the racial composition of Technikon Pretoria's student body changed dramatically almost overnight. This paper highlights the problems encountered and how they were dealt with to achieve harmony, not only within the institution itself, but also between the institution and the community. Although these changes were sometimes turbulent, they have resulted in a more mature institution well positioned to contribute to the country's Reconstruction and Development Plan.

1 Introduction

1.1 Pre-1992 South Africa

Until approximately 1990 interaction between the different racial groups in South Africa was severely limited by the policy of separate development. The majority of black people lived in semi-independent "homelands," under much the same conditions as they lived in one, two or five decades ago. Children were educated according to tribal culture, which rarely included any form of literacy in the western sense of the word. This education was provided by the tribe's elders, whose words were accepted without questioning by the younger members of the group. The perception of "ownership" by individuals did not exist to the extent found in the western world. Land, and almost everything on it, was thought of as belonging to everyone, to be used as and when needed. Generally, the interests of the group were considered to be of higher priority than those of the individual. Schooling, as it is understood in the western world, was provided by a system which can only be described as inadequate: poor facilities, unqualified teachers, large classes. The few "black" universities did not provide any training in the sciences and engineering.

In the white "homelands," western standards and norms were adhered to: materialism, individualism, competition and the right to criticise was the order of the day. The school system, although vastly superior to the black system, could be criticised for the perpetuation of the norms which may have been adequate 70 years ago: over-emphasis on the human sciences at the expense of the sciences and engineering, resulting in twelve years of schooling which had become so irrelevant to the needs of a modern society that fewer than 3% of school leavers could be accommodated in the labour market. The unemployed 97% inevitably tried to gain entrance into the tertiary system, where the vast majority, guided by their teachers and parents into believing that a degree of any sort was a guarantee of employment, graduated with degrees in the human sciences, only to find that they still did not possess skills for which there was an appreciable demand.

Despite legislation which allowed only a distinction between black and white, huge grey areas existed as black people were drawn to the economically active cities which were supposed to be exclusively white. Thus many black people were exposed to capitalism and the western way of doing things. The first and, to a certain extent also the second, generation of these people did not become totally westernised, but lived in an uneasy combination of traditional tribal culture and western capitalism and individualism. Data about the number of black people caught in this in-between world at the start of this decade, when the change in government took place, is unreliable but one can safely assume that the number is anything but insignificant.

One further phenomenon of the South African way of life has to be briefly described to put the remainder of this paper into context. The traditional universities, structured on the British and American format, turn out mainly (and in the case of traditional black universities, only) graduates in the fields other than the sciences and engineering, with only about 5% of their students studying in these "wealth creating" fields. In engineering, specifically, the qualification structure consists of a four year bachelor's degree, followed by masters degrees and doctorates. As far as engineering is concerned, the net result of the universities perched on top of the secondary school system as described, was a work force consisting of a few highly trained academics in a sea of unskilled labourers. This system left a huge gap for vocational training at a lower level than the universities provided. The technical college system was supposed to provide this need, but it too, has fallen into the trap of losing contact with industry and providing largely irrelevant training. Although several technical colleges have now seen the danger lights and are restructuring their courses, the student numbers at technical colleges are rapidly falling. This vacuum is now filled by the technikons, which came into existence in 1979. The phenomenal growth of the technikon system indicates that their philosophy of providing demand driven tertiary level programmes, curriculated in association with industry, and providing numerous exit points from one-year certificates to seven-year doctorates, is totally in step with industrial requirements in a developing country.

1.2 Technikon Pretoria Before and After 1992

Until the early eighties Technikon Pretoria had an exclusively white student body, with almost all of its students being sent there by employers. This system relieved the Technikon of the burden of selecting students, as they have already been selected by their employers. It also meant that its students were exceptionally well-disciplined, having been stripped of the irresponsibility characteristic of westernised youth by previous exposure to the real world. Constant liaison with employers ensured that the occasional misbehaving student was quickly and efficiently removed from the system.

But then two changes occurred in quick succession.

More and more employers realised that they could minimise their risk of employing an unsuitable person by requiring students to complete their Technikon training before employing them. At the same time the enormous costs associated with the previous system could be reduced. But intense competition between employers urged them to identify and employ students before they could finish their training, so that, since the late eighties, most students would start off as private students and find employment (or at least a bursary with the promise of employment) by the time they reached the second year of their three-year diplomas. Thus, the Technikon had to develop a system of selecting students since, in many cases, we received more applications than the number of available places. When the students came from a single schooling system, it was found that the students' performance in selected subjects (mathematics and general science, in the case of engineering) provided a perfectly good method of distinguishing between students who could study successfully on a tertiary level and those who could not. This new breed of students, who very often entered Technikon Pretoria straight from school without the benefit of a year or two of employment, also brought with them an increased level of irresponsibility and what normally goes down as "student fun."

The second change came about in 1995. Although there had been a slowly increasing number of black students at Technikon Pretoria since the late eighties, the change in government in 1994 resulted in a massive influx of black students at the start of the 1995 academic year.

These two factors, and especially the second, saw to it that the Technikon had to transform within a matter of a few years into an organisation completely different from what it had been before. Fortunately, the Technikon's core philosophy of providing industry-related vocational and career oriented education and training has remained intact and has, in fact, probably been the single most important factor to ensure its continued existence and growth. The strong demand from industry for Technikon Pretoria students holding three year diplomas in engineering, ensuring that such students can be virtually ensured of well-paid employment, has effectively limited student unrest to a few incidents of frustrating but minor importance. As a result, there is no demand for the bachelor's degree in engineering on a full time basis, but a strong demand for it on a part time and block release basis for working students.

2 Problem Areas Encountered

2.1 Residences

Technikon Pretoria accommodates approximately 3,000 of its approximately 13,000 Pretoria-based students in residences, either on its campus or in a number of city residences. The first black students who arrived from the rural areas in 1995 brought with them the first culture-shock. Their families arrived with them, and expected to be provided with accommodation and food for the few days of their stay. The practice of rural people to "stay over with the family" when visiting the city was quite a normal practice under white people half a century ago, but it was totally forgotten that it was still the norm under black people who did not possess the financial means or transportation to return home on the same day and whose family ties were still so strong that several of the new student's family members would accompany him or her to ensure that the new student would be well looked after in the new environment before returning home. This provided a problem of a proportion the Technikon simply could not handle, but good communication and a willingness on both sides to co-operate solved this initial problem amicably.

2.2 The Perception of Time

The typical white student has the typically western attitude about time: there is simply not enough hours in each day to do everything he or she wanted to do. As a result, these students are always in a hurry, and tend to be egocentric simply because there is insufficient time to tend to other people's problems. While one could rely on basic directions on where you might go to have your problem solved, any further requests for assistance would more often than not result in a more or less polite "Don't make your problems mine!"

Black people, because of their cultural heritage, consider any form of haste as inappropriate or even impolite. To the frustration of white lecturers and students, punctuality is considered to be of minor importance, and black people, even on government level, would often turn up hours late for an appointment if he or she had a problem of communal interest which required attention.

Quite understandably, these different perceptions can cause friction and require some flexibility on both sides. As an example, consider a white official sitting at a desk, who has to deal with the problems of several students in quick succession: each white student would hurry in, state his or her problem without even considering the possibility of sitting down, and expect it to be solved immediately. The black student, in contrast, would approach the official's desk as if the world's time was available, sit down (they consider it rude to have their heads higher than the head of a person they respect), and politely enquire about the official's well-being. Only after these niceties have been dispensed with, would the problem be stated. By that time, the white official, and the white students in the queue, would be fuming with impatience! A similar situation with a black official having to deal with students can be imagined.

Like so many other areas of friction and possible conflict, education of both groups in the culture and habits of the other, and a willingness to adapt (of which there is a plentiful supply on both sides) seem to be the only permanent solution.

2.3 The Individual Versus the Group

The typical white student the Technikon has become used to acting, in typical western fashion, as an individual who considered many aspects of his or her life as private, and who generally avoided drawing public attention. Therefore, such students would normally visit their lecturers individually to discuss problems, and would tend to keep their conversations private.

Black students, however, rarely approach a lecturer as individuals, but rather as groups. This is easy enough to deal with, but their habit to communicate over considerable distances simply by raising their voices to a suitable level often irritates whites. Contrary to the initial white perception that this habit was due to a lack of consideration for others, it is simply a result of the strong group-sense still present amongst blacks, even after a generation or more of exposure to the western civilisation. Black people do not consider any conversation as private, therefore they see no need to lower their voices if others are present, as whites tend to do. In fact, black people would tend to consider a softly spoken private conversation as mildly offensive, as if the speakers are hiding something from the group.

Another area where group-orientation versus individualism can create friction is in the often-heard demand amongst black students of "pass one pass all." To them, it was inconceivable that some members of a group who had attended the same classes and written the same examination could pass while others fail. Careful and repeated explanation of the fact that a Technikon Pretoria diploma or degree signified to industry that the holder of that qualification possessed the skills and fullness of knowledge required by industry, was the only guarantee that diplomats and graduates would readily find employment effectively neutralised that approach. We repeatedly explain that the Technikon had to issue only one diploma or degree to a student who did not meet these requirements to damage the excellent reputation the Technikon has to such an extent that possession of a Technikon Pretoria qualification would no longer guarantee employment. Pragmatism prevailed and the "pass one pass all" argument is now only rarely heard.

2.4 The Classroom Situation

In tertiary education, certainly in the Technikons' domain of vocational and career education, passive students who just sit and listen to a lecturer without interaction is quite unacceptable. Instead, students are encouraged to question the lecturer, to explore different solutions to case-study problems, to differ from the lecturer and amongst themselves. White students, especially once they have been exposed to the workplace, adapt to this situation quite easily. Black students who, traditionally, had to accept their elders' words without question and who consider it a sign of disrespect to question the lecturer or to differ from him or her, find it much more difficult to break this mould.

The only way to get black students to participate and to be critical seems for the lecturer to actively create a relaxed atmosphere and to encourage group discussions before individual discussions in the class room can even be considered.

2.5 Social Integration

Not unexpectedly, black students initially wandered around the campus in groups, quite separate from the groups of white students. This situation was undesirable, because any problem a black student would have with the system (and that was inevitable, with about 13,000 students) would quickly become the group's problem, and would result in "mass action" which could easily lead to intimidation of other students and damage to property. Technikon Pretoria has therefore worked actively to avoid the development of barriers based on racial differences, which was not always an easy task, given the country's history of racial separation.

White South Africans have traditionally been keen rugby players or spectators, and different sections of the Technikon, notably the residences, have for years been competing against each other on the rugby field. Black students, traditionally soccer enthusiasts, brought soccer to the campus. But there was no interaction between the white rugby enthusiasts and the black soccer enthusiasts—racial and sports loyalty seemed to be stronger than loyalty to the residence, faculty or whatever other section of the Technikon was represented on the sports field.

But South Africans have always been keen sports lovers, perhaps as a result of the country's fine weather. It was therefore not difficult to persuade students from technikon groupings to support the members of the same grouping participating against another grouping in a sport they did not know, so pretty soon white students were spectators at soccer matches where their residence or faculty competed against another and black students were spectators at similar rugby matches. As could easily be predicted, incorporation of whites into soccer teams and blacks into rugby teams followed almost unnoticed. As a result, racial differences, once the dominant factor keeping South Africans apart, has become of secondary importance.

3 The Way Ahead

3.1 Learning from Each Other

The most important breakthrough was the realisation that differences between groups did not necessarily mean superiority of one group over another, but rather that the different groups in the "rainbow nation" had much to learn from each other. Black people, amused by the whites' perpetual haste and insistence on punctuality, are slowly learning that these are prerequisites for success in a competitive world, both on a personal level and also on a global level. Whites, on the other hand, irritated by the black person's apparent disregard of time, have to learn that there is a fine balance between self-interest and the interest of the group and that whites have perhaps drifted too far towards self-interest at the expense of the group's interests. The multitude of orphanages and homes for the aged in the white communities, unheard of amongst blacks, will forever be an accusation against the egotism of white South Africans, as it is against almost all westerners.

Many similar areas where we could learn from each other, with mutual benefit, have become apparent over the last few years, and many more will undoubtedly develop with time.

3.2 Open Communication

We have learnt that open and honest two-way communication and a willingness to understand the other party's problem goes a long way towards the elimination of problems. Very often, problems are more imaginary than real, caused by different interpretations of what is being said, distrust or lack of understanding. The lessons learnt in the writing of the country's new constitution have gone a long way towards mutual trust and understanding. Although still far from perfect, communication has improved tremendously over the past few years, and will continue to do so. This applies to communication within the Technikon, and also with the community it serves.

3.3 Admission of Students

The country's primary and secondary school system is urgently in need of drastic changes. Until that has happened, Technikon Pretoria has the problem that students applying for admission are in many cases woefully unprepared for study at a tertiary level. This leaves the Technikon with two problems. There is no accepted culturally-neutral method for identifying potentially successful students, and even those who do have the required potential very often lack sufficient academic background to master Technikon courses.

While a lot of work is being done to develop such tests, Technikon goes out of its way to ensure that no prospective student applying for admission gets sent away without at least some sound advice about other opportunities. At the same time, several hundred students who have been judged not ready for Technikon education despite their secondary school certificates are being given a year's preparatory course. Several versions of these preparatory courses are being offered in the different faculties, and no doubt in a few years' time the "best" model will be selected to be used until such time when the secondary school system catches up. In the mean time, Technikon Pretoria is contributing more than its share to the country's Reconstruction and Development Plan by not only providing cost-effective tertiary training which meets the demands of industry, but also by rectifying the defects of the secondary system at its own expense.

4 In Conclusion

Together with South Africa, Technikon Pretoria has seen some staggering but exciting changes over the past few years. There can be no doubt that, as is the case with our country, Technikon Pretoria can confidently look ahead towards a bright future.

The Need for Industrial Human Resources Development in Developing Countries

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1. Introduction

A. Historical Perspective of Human Resources Development in Developing Countries

The history of human resources development in developing countries is rooted in the past educational system. The main purpose of the past educational system in most developing countries, especially in Africa, was to develop a high degree of literacy within the local community. The need for people who could read and possibly write was necessary for the administrative purpose in respect of transmitting messages, keeping accounts and being able to serve as servants. Thus, there was a high turn out of clerks, foremen in labour camps and, as the years went by, civil administrators, lawyers and educators.

The education system, geared to the purpose mentioned above, did not pay any particular attention to the development of creative skills and talent in the local community. The educational system therefore did not emphasise science and technology education or those programmes that could lead to the development of inventive skills in talented individuals. It was therefore difficult to generate the technical skills required for development, especially those related to science and technology and engineering.

B. Critical Developments in the World Economy Affecting Industrial Human Resources Development

The world economy is undergoing dramatic changes. In addition to radical advances in technology, including the development of advanced information systems and highways as well as material sciences, production is increasingly becoming globalised. The signature of the Uruguay Round Agreements has brought in a new dimension, since it globalises world trade. Together with the technological advances and the adoption of ISO 9000 and ISO 14000, production and trade are becoming more competitive not only on the global market but also on the local market. Their impact on local industry is already visible in many countries.

The developments in the world economy relating especially to the adoption of the Uruguay Round and other agreements, technological advances and competitiveness, including ISO 9000 and ISO 14000 have significant implications on the economies of developing countries. If these countries have to compete on the world market, they have to develop the technical competencies to master the production process, the technologies required and the quality specifications required at each phase of industrial production.

II. Challenges Facing Developing Countries in the Development of Human Resources Development for Industry

A. Globalisation of Production and Markets

The globlisation of production and markets, the shift from centrally planned to free market-driven economies and the establishment of trading blocks have brought about unpredictable employment patterns. This poses a great challenge to planners in developing countries to design and develop the right type of occupational skills at the right time and the right quantity and mix.

B. Advances in Science and Technology

The fast speed of development and advances in science and technology in the industrialised countries are, on the whole, steadily widening the gap between most developing countries and the developed and more developing countries. A key solution to accelerate the industrialisation of the developing countries is an urgent action in the field of science and technology. The new technologies and modern production methods and techniques depend on the development of industrial human resources and well-trained technical capacities, especially engineering capabilities.

C. Reform of the Educational System

In most developing countries, the educational system has not fully provided the appropriate learning opportunities for all children and adults, thus inadequate to build and strengthen the base for producing the right mix, in terms of quantity and quality, of the human resources required at each stage of the industrialisation process. It is needless to say that basic appropriate education is the cornerstone for building further education and development of sufficiently skilled and highly trained personnel to support high levels of industrial development. Without narrowing the gap between education system and science and technology, the developing countries would have no possibility of communicating with the scientific and technological community and of obtaining the skills and know-how needed for their sustainable industrial development.

D. Human Resources Development and Industrial Training Institutional Infrastructure

In general, most developing countries lack a well developed industrial human resources development and training infrastructure to support sustainable industrial, economic and social development. In general, industrial human resources and training institutions in most developing countries are not well equipped and lack some of the necessary technical, organisational and training capabilities to deal with the complex problems of human resources development for industry. Many of these institutions need further technical organisational and managerial support in order to be more fully utilised as "Centres of Excellence" at the regional and sub-regional level.

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E. Financing of Human Resources Development Programmes

While many developing countries allocate a significant portion of their national budgets to human resources development, these allocations are generally insufficient, especially in respect of science and technology education and industrial training. Furthermore, most of the resources are devoted to buildings and physical infrastructure rather than to programmes.

F. Human resources development policies, strategies and programmes

The lack of a long-term economic development vision and well defined industrial policy and strategy has made it difficult for many developing countries to establish coherent human resources development policies, strategies and plans. Together with the poor industrial human resources development and training infrastructure, these countries produce the skills which the national economy does not need and import at high cost what they really require.

II. Critical Considerations for Human Resources Development for Industry in Developing Countries

A. Establishment of a Long-Term Economic Development Vision

In order for developing countries to become an economically viable partner in the global economy and to derive maximum benefit from the Uruguay Round and other international economic agreements, to which they are party (having signed those agreements), there is a need for them to re-examine their economic development policies and to adjust them as appropriate. The key elements in that adjustment would include, for example, the establishment of a long-term vision, strategy and plan, restructuring of the economic base, including the formation and implementation of a sound industrial policy and strategic management programmes.

Short-term sporadic development policies and strategies will no longer suffice. Developing countries need to take a conscious decision to establish a long-term vision (15-20 years) for their economic development. Such a vision would in turn enable them to adopt a coherent and integrated industrial human resources development approach, to develop policies, strategies and programmes in line with the priority sectors and sub-sectors defined in their industrial development policy, strategy and strategic management programme.

B. Industrial Human Resources Development Strategy

Taking into consideration the requirements of the country, the national strategy for industrial human resources development should aim at adjusting existing or formulating, as required, a new policy for building up the relevant capacities and capabilities to sustain industrial human resources development and training institutions. Such a strategy should address industrial human resources development at the policy, institutional and enterprise level.

At the policy level, the strategy should aim at enhancing capabilities for carrying out industrial human resources development and training needs assessments, the formulation of industrial human resources development policies and elaboration of action plans and programmes. The strategy should facilitate linkages among the national educational system, science and technology and industry, thus more closely linking the programme of the educational system to the requirements of industry for well-trained scientists/technologists, engineers and managers. It should also provide for the development on industrial entrepreneurship and the private sector with special emphasis on small and medium scale industry and the integration of women in industry.

At the institutional level, the strategy should, among other things, aim at strengthening national industrial human resources capacity building through the training of trainers and managers, development of consultancy capacities and the production of training packages, manuals and documentation in priority areas. The strategy should also aim at:

1. Strengthening existing industrial human resources development and training institutions, establishment of new ones, as need be, and promoting their greater use in the design and conduct of training programmes responsive to the needs of a variety of target groups, especially industry.
2. Promoting industry-university linkage.
3. Establishing network systems and/or twinning arrangements with industrial human resources development institutions among developing countries for the development and transfer of know-how through exchange of information/documentation and training materials/curricula as well as exchange of training personnel (consultants, trainers, training managers), taking advantage of the ECDC/TCDC mechanism so as to benefit from the experience of other regions in human resources development.
4. Promoting regional/sub-regional co-operation through, inter alia, the up-grading of national institutions to become regional/sub-regional "Centres of Excellence."

At the enterprise level, the strategy should focus on the development of specific capacity building training programmes and activities to upgrade skills industry, including their introduction to new subjects and methods related to competitiveness, industrial management, quality assurance, acquisition transfer through strategic alliances and modern human resources development management.

C. Capacity Building in Industrial Human Resources Development

The building of human resources development capacities for industry in developing countries would relate to industrial leadership, entrepreneurship and technology.

Industrialleadership

The success achieved by any country in its industrial development depends upon its industrial leadership. Such leadership encompasses all levels, starting from political leadership through management leadership in public and private enterprises to leadership in local government and communities. Good leadership implies sound knowledge of development issues, statesmanship and proper governance, accountability and transparency.

It is therefore essential to embed right from childhood the basic elements of leadership relating, in particular, to professional competence and personal integrity. The respect and confidence which the population would hold to their leaders, irrespective of what position he/she occupies in the economy, would very much depend upon that leader's knowledge of development issues and his/her personal integrity. This aspect of human capacity development which is, indeed, the fundamental basis of the traditional culture of many developing countries needs to be further developed and applied rigorously.

Entrepreneurship

The development of any industrial economy depends to a large extent on the number of industrial entrepreneurs. Here, we are talking of hundreds of thousands on entrepreneurs and not of just a few hundreds. In most developing countries, most of these entrepreneurs are in trade and commerce. With the establishment of long-term economic development vision, a concerted effort has to be made to develop and promote more local industrial entrepreneurs in the productive sector. There are several small-and medium-scale industrial operations and micro-enterprises which lend themselves to family businesses and small entrepreneurs, who should be encouraged to exploit such opportunities through the establishment on an appropriate enabling environment and support measures.

Technology

The number of technical and engineering skills available in any country is an index of its level of development. Engineers are required practically in all sectors of the economy, agriculture, transport, communications, manufacturing, construction, etc.. There is therefore a need for special attention to be accorded to the development of technical and engineering capacities and, indeed, the whole range of technologists. In this regard, equal attention also needs to be given to vocational and trade-specific schools which are very much required to produce the great number of technicians required by industry. In a modern economy, the ratio between engineers and technicians is about one to six. In most developing countries this ratio averages around one to two.

D. Science and Technology Education

As indicated in the previous chapters, for developing countries to derive maximum benefit from the global economic changes taking place, particularly technological advances, globalisation of production and trade and competitiveness, it is imperative that in the development of their internal capacity and in the reform of their national educational systems and programmes, particular emphasis is given to science and technology education. Such emphasis would imply the establishment of special programmes and facilities, the development and wide utilisation of computer-based education, particularly in rural areas, the local production and utilisation of teaching/learning aids, such as audio-visual aids, toys, legos and other scientific games; and the establishment of science and technology libraries.

There would also be a need for the adoption of special incentives, such as national science and technology competitions for primary and secondary schools and university students, including participation in international competitions as well as special scholarships for science and technology education, both within the country and abroad.

In order to promote further science and technology education in the national educational programme, serious consideration should be given to the establishment of special schools for talented students in the field of science and technology. The school should be well equipped with scientific apparatus, laboratories and game rooms to provide an appropriate environment for talented students to exploit their inherent potential for invention and creativity. The schools should also be well staffed with specially trained teachers possessing modern techniques in science and technology education.

Apart from integrating science and technology in the overall educational system, there is a need to strengthen or establish a special training centre for science and technology teachers, the development and application of in-service refresher courses for science and technology teachers, the use of computers and other teaching/learning aids for science and technology education; and the establishment of science and technology educational exchange programmes among schools both within the country as well as within regions and other parts of the world.

Given the dynamic evolution of science and technology education in the world, it would be necessary for each developing country to establish an institutional mechanism and memory to keep abreast with such developments. Consideration should, therefore, be given to the establishment of a National or sub-regional Centre for Science and Technology Educational Research and Training, which, among other things, would (a) act as a "Centre of Excellence" for educational research in all aspects of science and technology education and training, (b) collect, analyse and exploit educational curricula for science and technology education from all parts of the world; (c) develop and promote local production of teaching/learning aids for science and technology education; (d) monitor world developments in science and technology education; (e) develop and promote the application of microelectronics (computers) in science and technology education, especially in rural areas; and (f) liaise with international organisations, such as UNESCO, ILO, UNIDO, as well as developing and developed countries in the field of science and technology education.

An important component of the national programme for science and technology education would involve the development and promotion of local production of teaching/learning aids, such as audio-visual aids (videos and radio programmes), science games and toys (e.g. legos, puzzles), and simple manuals, science books and hand-outs. These operations that lead themselves to small-scale production units by single families or individual local entrereneurs, who should be encouraged by the Governments.

E. Integration of Women in Industrial Development

In many developing countries, women contribute over 50% of the population. Furthermore, the number of female-headed households is relatively high and these households often represent the most disadvantaged section of the population. Considering the responsibility they assume in economic activities, especially in food production, strengthening their capacity is crucial to the socio-economic and industrial development. Thus, development problems cannot be solved unless policies and mechanisms are established that remove barriers inhibiting the maximisation of women's development efforts and their full integration in the industrialisation process.

F. Financing of Industrial Human Resources Development for Industry

The development and adoption of a national programme for industrial human resources development has to be accompanied with a sustainable financing package. It has often been said that investment in human resources development constitutes real capital formation. This is even more applicable to industrial human resources development. In the review and restructuring of the national educational system and programme and the associated national budget, special emphasis and allocations should therefore be made for industrial human resources development, especially for science and technology education. In most countries, the main responsibility for financing human resources lies with the State. While resources could be mobilised from the business community, multilateral and bi-lateral development agencies, the basic responsibility for financing this important sector of the economy still lies with the State.

The financial allocation for industrial human resources development should accord particular priority to programmes, especially in respect of the establishment of industrial human resources development and training institutions and vocational schools, science and technology education promotion of local production of teaching/learning aids and application of computers in human resources development programme. Particular emphasis should also be given to financing teaching/learning programmes and equipment rather than mere physical infrastructure.

In addition to government financing, the local business community, especially industry, also has an obligation to contribute to financing industrial human resources development. Such financing could be done through sponsorships, exchange programmes, prizes for competitions and other incentive programmes. The local industry could very much help to stimulate interest in children by organising factory visits and helping to organise industrial campaign programmes.

Negotiations with multilateral and bi-lateral financial institutions and technical co-operation and development agencies, such as The World Bank, UNDP, Fond de Développement Français, USAID, GTZ, AOTS, DANIDA, SIDA etc., industrial human resources development and training should also be emphasised as an integral component of all economic development programmes financed by those agencies. With regard to bilateral co-operation, special exchange programmes could also be promoted to enable co-operation between developing countries in industrial human resources development.

A number of international conferences has proposed the allocation of a certain percentage of GNP to human resources development, especially science and technology education. That proposal should be seriously considered by each developing country and appropriate measures taken for its implementation. A portion of that allocation should be earmarked for an Industrial Human Resources Development and Training Fund. Contributions could also be solicited from the business community in order to increase the volume of resources.

G. Creating an Enabling Environment

The transformation of the national economy into a modern and competitive economy in the world trade and production system would require the injection of a science and technology culture in the country. Such a culture implies greater sensitivity to time, figures, costs, efficiency and accountability in all sectors of the society, starting from childhood, when entering school, up to the level of statesman.

The development of a science and technology culture in the society does not imply a substitution or diminution of traditional national cultures. In Japan and East Asian countries, for example, their traditional cultures are fully intact in spite of their affluence in science and technology. There are, indeed, certain aspects of traditional cultures in many developing countries which could be further developed to enhance the creation of a science and technology culture in the country.

Given the history of education in most developing countries, civil administrators, magistrates, law enforcement officers and politicians enjoy special status in the society. Engineers, technologists and technicians who constitute the backbone of the productive sectors hardly receive any recognition. This is contrary to the prevailing situation in the developed economies, where equal status is attributed to executives in all sectors of the economy. The creation of an enabling environment for industrial human resources development must therefore pay particular attention to enhancing the status of industrial workers. This will go a long way to stimulating interest in children for work in industry.

Like any other economic activity, success in industrial human resources development will require the commitment by the political leadership, not only in Government but also in the private sector. A stable political environment is a necessity. Industrial human resources development should be of interest to leaders in other sectors of the economy, public and private sectors, civil society and the rural community.

H. Regional and Sub-Regional Co-operation

Given the limited markets, technological capabilities and financial resources of most individual countries, industrial co-operation and integration would continue to constitute a major long-term development option in developing countries. Treaties on the establishment of regional economic communities or co-operation schemes have gone into force among some developing countries. In the Arab countries, this includes the Arab Industrial Development and Mining Organisation (AID). Any programme on industrial resources development and industrial training must therefore accord high priority to sub-regional co-operation, utilising such institutions as AID.

Closely related to regional co-operation is interregional co-operation within the framework of ECDC/TCDC Countries, such as Brazil, Chile, India, Indonesia, Republic of South Korea and Malaysia dispose of valuable experience in industrial human resources development and training which could be shared with other developing countries. Some have expressed their interest to intensify existing or initiate new co-operation programmes in the field of industrial human resources development and training. These initiatives should be developed and pursued more vigorously.

IV. Recommendations for Action

In the light of the above, the following recommendations for action are advanced for consideration.

A. By Developing Countries at the National Level

1. Each developing country should give high priority in its national economic development policy and plan to industrial human resources development.
2. A national industrial human resources development needs assessment should be carried out and a policy and a plan and programme should be elaborated for industrial human resources development in line with the long-term economic development vision of the countries and the priority strategic industrial sub-sectors and areas defined in the national industrial policy and strategic management programme.
3. A comprehensive assessment of the national industrial human resources development institutional infrastructure should be carried out with a view to strengthening existing relevant industrial training institutions and new ones established as need be, with particular emphasis on the development and training of industrial leaders, entreprenerial and management capabilities, engineers and other technical skills, trainers and industrial consultants.
4. In connection with industrial human resources development and training institutions, the possibility of establishing specialised training centres (institutes) in priority national resource-based industrial sub-sectors such as food technology, petroleum, forest products, cement, etc. should be considered. Special attention should also be given to technical vocational schools and special science and technology schools and the greater use of computers in science and technology education, especially in rural areas.
5. At the enterprise level, the public and private sectors should co-operate with industrial human resources development and training institutions and universities in the formulation, financing and execution of a programme for the development and training of factory managers, engineers, technicians and other technical skills required for industrial production, quality assurance, industrial restructuring, rehabilitation and maintenance.
6. The government and the private sector should develop a sustainable financing plan or mechanism for industrial human resources development and training including the possible establishment of a **National Industrial Human Resources Development and Training Fund**. In this regard each government should examine the possibility of allocating a certain percentage of its national income to the Fund.
7. In negotiations with multilateral and bilateral financial institutions and technical co-operation and development agencies, such as World Bank or UNDP. Industrial human resources development should also be emphasised as an integral component of all economic development programmes financed by those agencies.
8. Concerted efforts should be made towards the development and promotion of local industrial entrepreneurship relating, in particular, to small- and medium-scale industries and micro industrial enterprises.
9. Each country should promote the local production of teaching/learning aids, such as audio-visual aids (videos and radio programmes), science

games and toys (e.g. legos, puzzles), and simple manuals, science books and hand-outs.

10. Particularly high priority should be accorded to special measures aimed at enhancing the integration of women in industry when formulating and implementing national policies, plans and programmes for industrial human resources development and training.

B. By Developing Countries at the Regional and Sub-Regional Level

1. Greater support should be extended to existing regional and sub-regional "Centres of Excellence," such as AID in the Arab region with a view to strengthening their capacities for industrial human resources development and training. The private sector, in particular, should be more actively involved in shaping the programmes of these institutions in line with their needs and should take greater advantage of the services they offer.
2. Measures should be taken to establish networks among industrial human resources development and training institutions in developing countries to enable a greater exchange of information, training programmes, trainers, etc..
3. The intergovernmental organisations, regional and sub-regional organisations in the region, such as the Arab League, the Islamic Conference, AID, the Gulf Co-operation Council, should accord high priority in their capacity building programmes to industrial human resources development and training.

In the formation and implementation of their industrial human resources development and training programmes, developing countries may wish to utilise, among others, the following integrated package of programmes developed by UNIDO which simultaneously considers industrial human resources development activities at policy, institutional and enterprise levels in the implementation of a holistic industrial human resources development system to support the development of sustainable economic growth:

(a) **Industrial Human Resources Diagnosis and Reorientation Map (IHRD-ROM):** An instrument to assess the comprehensive human resources requirements in specific regions, countries and industrial subsectors which serves as the foundation for planning of an effective human resources development strategy for sustainable industrial development.

(b) **Graduate Resources Integration Programme (GRIP):** An instrument for monitoring human resources development needs and development of policies and strategies from which effective subprogrammes and activities can be identified to narrow the gap between demand for and supply of skills.

(c) **Global Learning Opportunities in Business Education cum Industrial Network (GLOBE-IN):** A network system, including a data bank on human resources development and learning opportunities for industry among human resources development institutions in developing and developed countries as well as among economies in transition. The operational instrument on quality standards and norms for Executive Management and Technical Training-cum-Learning Opportunities for Industry.

(d) **Maximising Options Thinking for Visionary Enterprise Reformers (MOVER):** A methodology for promoting managerial and entrepreneurial skills by developing human resources development activities, addressing entrepreneurs as well as trainers and consultants for small-scale industries and other industrial enterprises.

(e) **Learn and Earn Programme (LEAP):** A scheme to integrate young people for more effective productive employment in industry. This programme complements the GRIP by expanding choices and providing opportunities for entry to industrial employment or entrepreneurship, particularly to those who for various reasons have no access to tertiary education.

C. By the International Community

I. The international community, particularly donor countries and development agencies such as World Bank, UNDP, UNESCO, ILO and the other organisations of the UN system should:
   A. Through UNIDO accord special attention to industrial human resources development and training in their co-operation programmes with developing countries and their organisations.
   B. Increase their technical assistance to developing countries and their organisations in industrial human resources development and training programmes.
   C. Contribute, if feasible, to the National Industrial Human Resources Development and Training Funds.
   D. Intensify co-operation with UNIDO in industrial human resources development and training programmes.

II. Within the framework of ECDC/TCDC, the more advanced developing countries such as Brazil, Chile, China, Indonesia, India, Malaysia and Republic of Korea should make available to other developing countries their experiences in industrial human resources development and training.

By UNIDO

In line with the high priority accorded by UNIDO to industrial human resources development, the organisation should:

a) Continue to accord high priority to industrial human resources development among its programmes and activities.
b) Intensify efforts towards the mobilisation of financial resources to support industrial human resources development programmes in developing countries.
c) Review, refine and finalise the operational instruments for industrial human resources development to enable their wider application in developing countries.

V. Conclusion

This paper presents a number of reflections on issues which should be taken into consideration in the development of industrial human resources in developing countries. It emphasises the need to pay particular attention to the formulation of national long-term economic development visions; industrial human resources development policies, strategies, plans and programmes and science and technology education. It stresses the need to develop industrial leaders in government and industry including industrial entrepreneurs; adequate institutional machinery, technologists, especially engineers and technicians; and women's programmes to ensure their integration in industry.

The paper advances a number of suggestions for consideration. These suggestions are not exhaustive, but constitute a basis to initiate discussions. Much more detailed work will have to be carried out, drawing on the experiences of the more advanced developing countries and relevant international organisations and development agencies, in order to define and formulate industrial human resources development and training programmes tailored to the specific needs of individual countries.

The world economy is undergoing significant transformation. For developing countries to participate actively in global production and trade, it must build the technical competencies required to enable them to compete in the increasingly globalised economic system. The building of industrial capacity will very much depend on the creation of the right type and quantity of industrial human resources and at the right time. International co-operation will be indispensable and the role of UNIDO and other international organisations will be most crucial.

In order to achieve success, there is a need for the national leadership and the private sector in each developing country to be fully committed to the process and for adequate financial resources to be allocated. This is tantamount to revolution of the national economy and presents a major challenge which, with the political commitment and will, can be successfully handled.

Prospects for Trade and Industry in the UAE

Mr. Anis Al Jallaf
Managing Director and CEO
Emirates Bank International

The Economic Reality

Over the past decade much has been made of the UAE's need to reduce its economic dependency on oil and the lessons learnt in 1986 (prices crashed to US$ 8) soon showed the wisdom of that approach.

If 1986 now seems a long way away, let me bring you more up-to-date with the fluctuations of oil revenue and the risk of over-dependency on the earning power of this natural resource.

In 1992 , oil production was disrupted in the former Soviet Union and Iraqi oil was totally absent from the international scene which you may think a perfect recipe for increased oil prices. In fact, prices remained weak for a considerable period of time. Of late, oil prices have been high and this is despite the return of Iraqi oil to the market. The price for Brent in April, 1997, ranged from US$17.68 to $18.66 per barrel. Stories such as these show just how vulnerable we could be and highlight the need to boost the non-oil sector and create a multi-resource economy.

GDP Since 1988

A brief look at the GDP growth since 1988 confirms that UAE's diversification plans are now paying dividends. You will note that from 1988 there has been a steady increase in contribution from non-oil sector to our GDP and its rate of growth has been encouraging. The non-oil contribution is estimated at around 64 % of the 1996 GDP, which is a far cry from around 36 % 25 years ago.

Non-Oil GDP

A closer look at the more recent figures shows a substantial improvement in our non-oil GDP from 1992 when it stood at Dh.77.9 billion to 1995 by which time it had climbed to Dh.94.7 billion, reaching two-thirds of our GDP. 1996 estimates include a 7% increase in the non-oil GDP, confirming the growing trend witnessed in this Sector.

These figures may lead you to think that we are not as dependent on oil as we have previously been led to believe. But in fact we are because it is oil revenue that determines public sector expenditure, which has a direct effect on the private sector. We need oil income to fuel public expenditure and we need the public sector to boost the fortunes of the private sector. We need to hang on to the belief that oil remains the centre of our economy. It does provide for approximately 75 % of the UAE's public revenue.

We should not lose track of the need for public spending to increase sustainable oil production capacity and to increase gas production in order to meet the growing export demand.

Trading

Given that we have decided that the future lies in the growth of the non-oil sector, the first non-oil activity, which comes to mind, is trading. Its continued upward trend over the years has encouraged us and the UAE has made a serious attempt to consolidate its position as a trading hub of the region.

Total Non-Oil Foreign Trade—UAE

Trade volumes have shown a steady rise over the years and in 1995 was estimated at UAE Dirhams 100 billion. Over the last few years the UAE has taken significant strides in developing the re-export market which has shown steady growth.

Traditional markets of Iran and the GCC, Indian Subcontinent and more recently CIS countries have immense re-export potential and we can expect to see growth from these and the emerging markets. On the other hand, non-oil exports have increased and, as the prospects of value additions take root in the UAE, their potential can not be underestimated.

Growth in trade has however been traditionally linked with growth in sea borne transport, which remains central to overall growth in trade. We have noticed a major trend to include air and land transport. Though demand for cargo is considered a derived demand, the rapid growth witnessed in dry bulk commodities and containerisation has been very much a result of the development seen in the shipping industry itself. Given the growth in regional re-export trade, there is potential for developing regional feeder services to enhance third country trade.

Trading was the nation's strength long before oil was discovered. It has taught us to be hard-nosed businessmen, resilient during economic down-turns and constantly seeking new opportunities. It is this background which gives me the confidence that, given the continued focus on trade, we will achieve world leadership in time to come.

The Non-Oil Sector of the UAE

Before I move on to the contributions made by industry, it is important that we take a look at what constitutes the non-oil sector. Our main non-oil activities with significant contribution to GDP are:

- Government and related services
- Trade Restaurants and Hotels
- Construction
- Manufacturing

Manufacturing though currently lying in the fourth place, is growing rapidly. This sector has the capacity to absorb the liquidity and investible surpluses available in the economy. Though initially manufacturing was almost entirely confined to large public sector investments in the oil and gas fields, this has undergone a change in recent times. We now see small-scale light industries and processing plants in virtually every Emirate.

Manufacturing Industry

Manufacturing in the UAE today covers a wide range of activities such as chemicals, basic metals, machinery and foodstuffs.

Time is now ripe to build on the experience gained and move into medium to large-scale manufacturing to cater effectively to the GCC market and the growing economies of the region.

And there are keen investors as well who are not only aware of the advantages of setting up their regional base here but also discerning enough to appreciate the security environment and the incentives offered throughout the country.

A light-hearted observation of a recent investor was, "The UAE is Miami without the violence and insecurity, not to mention the taxes."

Capital Markets

To make this a reality, a comprehensive legislative framework is necessary to facilitate public ownership of businesses. Steps have been taken to improve the UAE's legislative framework to bring it in line with its commercial aspirations. We have introduced the Commercial Transactions Code, Commercial Companies Law, Copyright Law, etc.. These legislations have facilitated an improved business environment. Much, however, still remains to be done to promote public investments, and though public offerings are being made, the pace needs to be quickened. The public floatation of a number of companies is a step in that direction.

We need a legal framework which provides a comprehensive guide to capital market activities and addresses the:

- Regulation of the securities market
- Establishment of a stock exchange
- Establishment of clearing settlement and depository body.

The Central Bank is pressing ahead with the project and I am confident that, with these in place, a primary market culture will become a reality and capital markets will receive a major boost in the years ahead.

Offset Programmes

Sales of military equipment in recent years have already carried offset obligations and the investments here can run into substantial amounts. Offset programmes provide opportunities for partnerships in viable projects.

Introduced in 1990, there are currently about 24 announced offset projects which a capitalisation of approximately US$ 300 million. There were three new offset ventures announced during the IDEX (International Defence Exhibition), in March this year.

Offsets has become a well established and an important contributing partner toward the UAE's industrialisation and this development will take us a step closer to becoming a manufacturing economy.

Services

The simplified guide to the future, of course, does not mean that other sectors will have no role to play. The consumer market will remain and grow. The services sectors will be one of the growth sectors with tourism playing an important role and contributing to the GDP.

Tourism

We have slowly but surely worked our way onto the international tourist map. In 1983, total visitors to the UAE was 373,000 which in 1995 increased to 1,600,000. The latest estimates for 1996 put this figure at 2 million. A number of factors has contributed towards this end. In the region we are both economically and politically stable. Our infrastructure compares with the best in the world and continues to improve. We have effectively combined adventures and leisure with the traditional tourist attractions of heritage and shopping. The UAE's track record on public safety is excellent and continues to improve because we are aware that tourism is the stimulus to the travel trade, to the hotel trade, to the services sector and also necessary to boost the economy. The business travel trade, coupled with exhibitions, projects the country's image and has opened up avenues for new investments.

The Future

Post-GATT and WTO, we will still have the geographic advantage of being a lot closer than the West to India and the Far East, which are now being seen as the major economic players of the future. There is no doubt that GATT and WTO will present us both with challenges and opportunities.

This will mean the opening up of world trade, pulling down of barriers and a new way to doing business. This will open up bigger markets and the UAE would be a good place to be in.

We can meet these challenges because of free market thinking which is in our veins. With the right planning, we are well placed to take advantage of the emerging opportunities.

Reforming Technological Education

H E Sheikh Nahayan Mabarak Al Nahayan

Minister of Higher Education and Scientific Research,

Chancellor Of the Higher Colleges of Technology

Good morning, Ladies and Gentlemen:

I am pleased to be back with you this morning. I trust you have become excited about the conference activities and following a restful night, are ready to pursue today's agenda.

I believe this timely conference provides us with a special opportunity to study successful models and practices in the area of technological education, as well as a chance to identify challenges and opportunities.

Our interest in technological education in the United Arab Emirates derives from our appreciation of the role of modern technologies in the process of economic development. We believe that a system of high quality technological education and training is essential to our ability to respond to the changing needs of our economy.

The title of my talk is "Reforming Technological Education". I have had the privilege, over the last decade, to be intimately involved with the development of our Higher Colleges of Technology. And, from this experience I have followed closely the developments in the field of technological education. It is evident that technological education is now in the midst of a new era of development, both in scope and in content. This is a response to major changes occurring at all levels of human endeavour.

We are witnessing very rapid and important advances in technology. Computers are revolutionising everything around us. Telecommunications are becoming a major part of the industrial infrastructure. Technology is being effectively integrated within all areas of human activity. The workplace dynamics and needs of employers are changing. Advances in materials, instrumentation, conceptual and analytical technologies and methods of processing information and data are forcing us to rethink the basic principles of technological education. Above all else, economic competition, which has become dependent mostly on national technological capabilities, is now the basis of the new world order.

Under these circumstances, the modern technologist must have the insight to operate in a changed work environment. He must have the ability to integrate a good understanding of technology with practical knowledge and hands-on-orientation. The technologist must be equipped with the skills for taking initiative, for critical thinking and for carrying out problem solving tasks. He must be well prepared to learn new skills as technology advances. The technologist should be able to express himself or herself clearly, orally and in writing, must have the ability to function as a member of a team and must always appreciate the social, economic and political dimensions of the work environment.

I believe that successful technological education requires the development of principles and traditions that make our colleges and institutes adaptable and flexible in responding to change. For this to occur, issues of planning, programme quality, curriculum, support, linkages, practice, assessment and accountability must continuously be addressed.

Effective technological education requires an institutional culture that continuously focuses on important issues such as:

- Manpower requirements for technologists in various fields, both in the public and private sectors
- The knowledge and skills needed to meet these manpower requirements
- Access to new information and knowledge for curriculum development
- Essential information and knowledge about newer technology and how to maintain equipment currency
- Research and creative activity to support innovation and student learning
- Professional development for faculty and administrators
- Technology transfer and the role of technological education in boosting the use of technology in the community
- The types of strategic alliances with local and international institutions and the processes by which these alliances may influence the content and delivery of educational programmes
- Performance of graduates in the work place and the reputation and status of technological education in the community
- Systematic programmes of outcomes assessment.

At the Higher Colleges of Technology of the UAE, these important issues are always at the heart of our operations. And we continuously strive to address these concerns. The Higher Colleges, over their nine years of operation, have developed some basic guidelines for the process of their continuing renewal and improvement. I want to outline these guidelines for you as we discuss reforms of technological education.

First, we believe that the curriculum in technological education must provide considerable breadth, depth and intensity. It must be closely tied to the requirement of the local labour market — now and in the future. It must encourage hands-on learning and aim to produce motivated self-learners and to cultivate leadership skills. It must consider practices and innovations at similar institutions in other parts of the world. The scope and content of the curriculum must always be flexible, focusing on the students and assisting them to engage in life enhancing activities.

Education technology, including computers and computer-aided instruction, must be recognised as important educational tools and utilised to enhance the quality of technological education. Technology offers tremendous opportunities to improve teaching and learning. Laboratory equipment must be kept up-to-date. All necessary steps must be taken to attract and retain qualified faculty members and to encourage them to develop appropriate educational technologies.

Our experience at the Higher Colleges indicates that excellence in technological education is driven by the quality of what transpires in our classrooms and laboratories. Students must be held to high expectations of performance, be required to participate fully in the learning process and be provided with useful assessment and feedback. A strong commitment to quality and an unflagging concern for superior student achievement are important elements in our institutional environment.

In addition, interaction between college and industry must be strengthened. Closer ties can lead to the enrichment of academic courses, improve co-operative programmes, provide students with the education and skills they need to excel in the workplace, identify priorities for technology transfer and produce the necessary co-ordination in the area of continuing education. We are always exploring opportunities for collaboration and joint partnerships with other sectors to improve education and training.

Efforts are also made to increase the flow of qualified and interested students to our Colleges of Technology. Strengthening relationships with secondary schools is a top priority. Programmes for student orientation and efforts to improve the teaching of science, mathematics and technology in our secondary schools are supported and promoted.

We also recognise that the elements of assessment and accountability are important to the success of technological education. It is essential to develop ways to describe the results of our efforts in terms of student outcomes and the proficiencies of graduates. By focusing on accountability, we can demonstrate results, continue to build our base of public support and be viewed as an important societal investment rather than a mere expenditure or a cost.

And lastly, we believe that the success of technological education requires the support and interest of society's leadership and of the general public. The challenge here is to align technological education with the demands and requirements of social and economic conditions.

These are some of the qualities that serve us so well at the Higher Colleges of Technology. These qualities have enabled the Colleges to be responsive, flexible and effective. Most importantly, the Colleges are able to set clear and sound priorities and to make choices based on those priorities. As a result, the Colleges have come far during their short history. This conference, by focusing on the problems facing the development of technological education, can help us proceed to the next levels of achievement.

In closing, let me reiterate my strong belief that effective and relevant technological education is essential to all efforts aimed at building a quality work force. Our goal for this conference is to take stock of current developments and to set the bearings for the future of technological education. I strongly believe that our success with this issue can make a significant difference for individuals and for national economies everywhere.

Thank you.

School-to-Work Policy Insights from Recent International Developments

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Executive Summary

In countries where young people have been relatively successful in both achieving high academic standards and making smooth transitions to employment—notably, Japan and Germany—employers have taken major responsibility for their training. German employers play a lead role in the famous "dual system." Japanese employers provide extensive training to recent school graduates after hiring them. Policy makers in other countries have therefore been attempting to emulate this success by increasing employer involvement in the training of young people.

Now the emergence of a more "learning-intensive" economy poses new challenges, both for countries with hitherto successful systems and for others. Employment is becoming increasingly fluid, occupational boundaries are changing or dissolving, and more jobs are temporary. Continual learning is a more important part of work, both because some organisations are giving more responsibility to front line staff for solving problems and improving procedures, and because more people are obliged to move from one employer to another. Organisations are seeking to promote learning and at the same time contain the cost of training through "on-line learning" strategies such as cross training within work teams, job rotation, and skill-based pay.

Traditional forms of education do not provide the best preparation for this emerging economy. Vocational education has tended to become too focused on specific skills and occupations that are likely to change in the future. Traditional academic education by itself is also inadequate, because it does not equip students to apply their abstract knowledge or to learn in the context of practical problem solving. In response to the perceived insufficiency of traditional education and training to prepare young people for more learning-intensive work, recent policies in many industrialised countries are converging on four principles[12]:

- New curricula should be created that integrate academic and vocational studies.
- Occupational and educational performance standards should be explicitly related to each other.
- To prepare for learning-intensive work, initial education and training should include a certain amount of work-based learning for all students.
- Employers and educators, including both academic and vocational educators, must share both responsibility and power in new school-to-work systems.

The first principle is the most fundamental from the perspective of US policy, because it affects how the others are implemented. Work-based learning, performance standards, and school business partnerships often occur in countries that maintain strict separation between occupational training and academic education. These practices, by themselves, will not achieve the integration of academic and vocational education that is now being recognised as desirable in most countries.

To prepare individuals for work that demands autonomy and continual learning, many employers now call for education that promotes high-level thinking skills for all students, not just for the elite as in the past. Vocational education, which in many countries traditionally has offered practical training for students who were considered to possess relatively low academic ability, is now being reformed and in some places radically reconstituted. Reforms include strengthening the academic content of vocational preparation, as in the programme of study for the French vocational secondary diploma instituted in 1986. In Germany, where many apprentices have traditionally received a high level of theoretical instruction as part of their training, there have been efforts in recent years to bolster the academic content even more. Countries are also making it easier for vocational graduates to pursue further studies at the university level, as in Germany where 30 percent of university students in 1994 had completed apprenticeships in the dual system. These changes are intended to attract larger numbers of intellectually talented students into vocational programs, to give them sufficient theoretical grounding to deal with changing technology, and to prepare them for continual problem solving.

As change proceeds in this direction, the line between vocational and academic education becomes less distinct. Instead of serving as an alternative to general education, vocational education becomes a method for promoting it. For example, in 1991 Britain began developing "General National Vocational Qualifications" which enable students to qualify for the university through courses of study that focus on broadly defined industries. In 1994, Japan started offering a new "integrated course" that permits high school students to design individual study sequences preparing them for both careers and higher education. These initiatives to start blending vocational and academic education mirror the increased merging of production and learning in the workplace.

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[12] In this paper, "academic" refers to a programme of study that is primarily intended to prepare students for higher levels of formal education, and "vocational" refers to a programme of study that is mainly intended to prepare students for work. Ordinarily, traditional academic courses are more abstract and theoretical, while traditional vocational courses are more concrete and applied. However, as will be noted, some traditional vocational programs in fact may include more theoretical and abstract subject matter than some academic programs.

Formal standards and certification procedures, which specify what individuals should know and be able to do, are important elements of a school-to-work system. Many countries are now re-examining their standards or establishing new ones. Countries with well-established occupational training systems have been reducing the numbers of specific occupations to promote workers' flexibility, and including more generic work skills. But occupational and academic standards have usually been defined separately. These changes in occupational criteria can be carried out without bridging the separation between academic and vocational streams. For example, in Germany, where approximately two-thirds of the youth population participates in apprenticeships, the reform of vocational standards affects most young people but does not entail changes in the academic curriculum of upper secondary schools (*Gymnasien*) geared to university preparation.

Other countries are trying to develop vocational credentials that can serve as a step to university and other forms of higher education. England and Scotland have made some progress in this regard. The Netherlands and Denmark have developed vocational routes to higher education. Growing numbers of young Germans who graduate from academic high schools are completing apprenticeships before going on to universities, and the theoretical preparation of German apprentices is becoming even more rigorous. Countries that are following this path sometimes invoke the goal of achieving "parity of esteem" between vocational and academic education. No country has yet developed a unified secondary school structure based on one set of credentials for both vocational and academic studies, but current reform plans in Scotland call for an integration of many previously separate vocational and academic programmes while still maintaining separate vocational credentials for many students. The state of Victoria in Australia has achieved a relatively complete integration of the formerly separate vocational and academic secondary school systems, including new curriculum and assessment methods (Raizen et al. 1995).

Because one hallmark of the emerging economy is the necessity for continual learning in the context of work, a logical implication for initial education and training is that schools should give young people some experience in work-based learning. By gaining practice in the deliberate use of work to develop knowledge and skill, young people should be better prepared for a lifetime of on-line learning at work. There is some evidence from France that this is so. Two basic strategies for work-based learning are classic apprenticeship and school-supervised work experience. In a classic apprenticeship, trainees have some of the rights and benefits of regular employees as well as some special entitlements. The German dual system is the biggest example of this kind. Several countries including Britain, the Netherlands, and Spain have recently created new apprenticeship systems or expanded existing ones. The same countries, and others including France, Korea, and Sweden have also taken major new initiatives to expand work-based learning for students who are still under school supervision.

While some students in lower-secondary or middle school participate in school-supervised work experience that is broad-based and exploratory, most of the newly created work-based learning is for upper-secondary students and is still tied to vocational education with no connection to academic subjects. Unlike some incipient efforts in the United States, most of the new initiatives in other countries do not attempt to combine work-based learning with an integrated curriculum designed both to prepare young people for work and to maintain their option of enrolling in a university r other selective institution of higher education.

One form of school-supervised work experience is school-based enterprise, which engages students in production of goods or services for other people as part of a class or related school activity. Denmark recently has expanded the use of school-based enterprise in vocational education, to supplement the number of training places available in outside firms. Some German apprentices spend a portion of their time in school-based enterprises within enterprise-based schools. Like other forms of school-supervised work experience, school-based enterprises both in other countries and in the United States have mainly been part of vocational education, although a British initiative in the 1980s promoted mini-enterprises within the general academic curriculum.

Development of work-based learning and links between occupational and academic skill standards call for increased sharing of power and responsibility between educators and employers. In countries where schools still carry the main responsibility for education and training, the role of employers has increased. For example, in recent years employers have taken a more active part in the governance of work-related education and training in Australia, Britain, and France. Both in these countries and in Germany, where employers traditionally have had a major say, the employers' participation in governance has been limited to vocational education, however. Employers still exert little influence on the curriculum of secondary schools or programmes whose primary mission is to prepare students for selective institutions of higher education.[13]

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[13] With respect to Germany, however, Jeff King has written to us that "there is a strong de facto influence on academics by employers of the most fundamental kind: they teach college level academics in the firm. US college-level academics are taught, in firms, by firms. That is influence: academics are 'owned' not just by schools and universities; they are also the province of firms—and schools and universities know and respect that. There are all manner of shared educational and policy institutions protecting and encouraging this arrangement. Employers, through their technical education committees are ... part of the national committees for education curricular frameworks bearing on the foundational academics for most youth and most occupations (all but graduate level university professional fields). They explicitly review and help structure curricular content in academic foundations, at levels comparable to US college levels, in coordinating what elements are taught in schools and what taught or reviewed in firm classrooms. Thus they help shape academic curricular content, along with education policy people, at state and national levels. Hence: *they validate academics at all levels, create a market for it, keep pressure on schools to maintain highest standards in it, and tie it to applications and work-life contexts on a continuing basis, proving its value in contrete ways to students, families and the larger society*. This is very powerful influence."

This report concludes that industrialised countries in Europe, Asia, and Australia are pursuing reforms similar to those under way in many American communities: overcoming traditional distinctions between academic and vocational curricula, and combining the two with work-based learning in an integrated course of study that prepares students both for careers and for college or university. Since every country has its own unique set of institutions, the reforms take a different shape in each context. Some countries are just beginning to move in this direction; others are continuing a process begun decades ago. In spite of the differences, the fact that most industrialised countries have now decided to undertake similar changes suggests that the reasons for them are strong and pervasive.

I. Policy Implications of Past Successes and Current Trends

Lessons from Successful School-to-Work Systems

A successful school-to-work system would equip all young people with high levels of academic and occupational knowledge and skill, and would enable them to find employment that uses their capacities. By this definition, the OECD countries with the most successful systems in recent years have been Austria, Germany, Switzerland, and Japan. In these countries, students score relatively well on international tests in academic subjects (OECD 1995a) and unemployment rates among 15 24 year olds are relatively low (OECD 1995b).

In each country with a successful school-to-work system employers take major responsibility for training. German, Swiss, and Austrian employers hire and train apprentices in the well known dual system. Japanese employers maintain long lasting relations with schools, and provide extensive in-company training to newly hired graduates. Students in all these countries have a clear incentive to perform well in their academic studies because they are more likely to get good jobs if they earn good grades in school (Rosenbaum and Kariya 1991; Soskice 1994). The successful systems, especially those in Europe, also depend on widely recognised systems of skill standards and certification.

Public authorities in countries with less successful systems have been trying to emulate successful countries by involving employers more closely in the education and training of young people. The 1994 School-to-Work Opportunities Act in the United States was intended to stimulate the introduction of "work-based learning" on a large scale in American high schools. The Goals 2000: Educate America Act created a National Skills Standards Board to develop and oversee a system of voluntary industry based skill standards. Similar initiatives have recently been taken or are currently under way in Australia, Britain, Denmark, France, Korea[14], Spain, Sweden, and elsewhere. These measures, described in a later section, have been prompted mainly by the hope that stronger employer involvement, closer ties between schools and the workplace, and more effective systems of skill standards and certification can improve the performance of young people in school and work.

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[14] The situation in Korea, which was invited in 1996 to join the OECD, differs from the others. The Korean system has been successful on the criteria of high academic performance and low unemployment. However, in recent years, some university graduates have not been able to find immediate employment—an unprecedented problem in Korea—and this has caused concern that too many students are choosing secondary school programs that lead to university instead of work. In an attempt to increase the attractiveness of vocational education, the Korean government has been promoting a "2 + 1" programme under which students in vocational and technical high schools spend their entire third year at the workplace.

Generally, the youth unemployment rate varies with the rate of unemployment among adults. Figures 1–4 in the appendices display unemployment rates in OECD countries for 1979, 1983, 1990, and 1993.[15] Unemployment rates for adults between the ages of 25 and 54 are plotted on the horizontal axis, and rates for youth between the ages of 15 and 25 are measured on the vertical axis. For most countries, unemployment rates for both age groups were higher in 1983 and 1993 than in 1979 and 1990. In each year, countries with higher unemployment among adults tended also to have higher unemployment among young people. The straight line in each figure is the ordinary least squares regression line showing the average relationship between youth and adult unemployment rates. Most countries lie fairly close to the line, indicating that the adult unemployment rate is usually a good predictor of the youth unemployment rate. The simple correlation between youth and adult unemployment ranges from 0.53 in 1979 to 0.82 in 1993. This means that whatever set of conditions and policies cause a country to have relatively low or high adult unemployment also tend to cause youth unemployment to be relatively low or high, compared to other countries.

Using youth unemployment as a criterion, the US school-to-work transition system is not the worst in the industrialised world, as has sometimes been alleged. That distinction should instead be given to the Mediterranean countries: Italy, Spain, Greece, and to a lesser extent France. Unemployment rates in the United States tend to be near the average for OECD countries, or slightly below it. The US data in Figures 1–4 lie very close to the regression lines, indicating that youth unemployment tends to be almost exactly what would be predicted on the basis of adult unemployment.

Other recent comparative data (OECD 1996) indicate that in recent years the US school-to-work system actually appeared to be relatively effective. Long-term unemployment among 15-19 year old males in 1994 was lower in the US than in any other OECD country for which data are available. For 15–19 year old females only Sweden had a lower rate than the US (Table 4.4). Similarly, among a set of 21 OECD countries, the US employment-to-population ratio for 20–24 year olds was also near the top: 74.6 percent for males and 64.5 percent for females (Table 4.2). In particular, this compared favourably with Germany where the employment rate was 67.7 and 65.7 percent for males and females, respectively. These figures reflect the robustness of the US economy in 1994 compared to other industrialised countries.

It is important to note some of the limitations of the unemployment rate as a measure of labour market success. The unemployment rate is the number of individuals who do not have paid work and are actively seeking it, divided by the number in the active labour force, which comprises the employed plus the unemployed. "Discouraged workers," who are not employed but not actively seeking work, are not counted in the active labour force. Neither are incarcerated individuals—a relatively large group in the United States—nor secondary school graduates who failed university entrance examinations and are studying to take them again—a relatively large group in Japan, France, and the United Kingdom. The employment-to-population ratio, which includes the entire population in the denominator, makes no attempt to separate job seekers from non-seekers, but this is not necessarily a more valid measure. Furthermore, none of the employment or unemployment rates says anything about the quality of jobs that people hold.

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[15] The data are from OECD 1995b, Statistical Annex Table B.

Notwithstanding these limitations, Figures 1–4 indicate the success of Germany and Japan in keeping youth unemployment low, both in absolute terms and relative to adult unemployment. The one available data point for Switzerland, in 1993, also shows a low absolute and relative rate of youth unemployment. In these countries, employer involvement in setting standards and maintaining incentives in the education and training system ensures a flow of new employees who can achieve high levels of quality and efficiency at work. This helps firms expand their market share and create more jobs, as long as workers' compensation does not rise so fast that it precludes profits for investors.

Implications of Emerging Trends

Nevertheless, the conditions on which these systems are based appear to be changing. In the past, the transition from school to work has meant finding stable employment in an occupation, industry, or company. Now employment is becoming increasingly fluid, occupational boundaries are changing or dissolving, and more jobs are temporary (Cappelli 1995; Carnoy 1995). Because employers themselves are being forced to become more flexible in response to more rapid mobility of information and capital, work is increasingly "learning-intensive." This is true in large firms that are involving employees in continual problem solving. Continuous learning is also necessary for the growing number of workers who move from one temporary job to another (Seavey and Kazis 1994). As described in the next section, employers are being pushed to explore new methods to engineer learning into the work itself. The boundary between learning and production is becoming increasingly difficult to define in many work situations. Under these new conditions, employer involvement in school-to-work systems no longer means helping schools train students for predictable jobs. Instead, employers and schools together are caught up in an evolution toward some new institutional arrangement where flexible production and continuous learning must happen at the same time.

This trend poses a challenge for school-to-work systems that have functioned well in the past in Japan and the German speaking countries, as well as for countries where the school-to-work transition has already been relatively difficult. One challenge is to overcome the rigidity and fragmentation that sometimes afflict vocational training. Rapidly shifting markets and technology leave narrowly trained workers vulnerable. Preparing young people for hundreds of specific occupational categories may not be appropriate for the fluid world of learning-intensive work. Therefore Germany and other countries where training systems are organised around strictly defined occupations have taken steps to reduce the number of vocational lines and broaden the skills that vocational students are taught.[16]

A second major challenge to traditional systems is that many students are turning away from vocational tracks and seeking to enrol in academic streams leading to university. Increasingly, higher academic education is seen as the road to higher income and status. Even in Germany, there is some evidence that employers are recruiting higher education graduates for positions that had previously been filled by internal promotions of apprenticeship graduates. "The traditional careers of skilled workers are in certain sectors threatened by the competition of graduates from *Fachhochschulen* [polytechnics] and universities," according to Durand Drouhin and Romani (OECD 1994, p. 11).

In some German industries, a traditional career path has begun with apprenticeship leading to employment as a skilled worker (*Facharbeiter*), then followed by additional training at *Fachhochschule* and subsequent promotion. For example, Mickler (1996) has observed this career pattern in the machine tool design industry, where traditionally a large proportion of design engineers began as apprentices and skilled workers. Such engineers have had the advantage of being able to communicate easily with skilled workers responsible for actually producing the new tools or prototypes. However, the advent of computer assisted design and simulation has led companies increasingly to recruit new engineers from among recent university graduates who are theoretically trained in experimental procedures, informatics, and electronics, but who have not served apprenticeships or gained experience as skilled workers. Mickler reports that the proportion of university-trained engineers in this industry grew from 17 percent in 1961 to 28 percent in 1987 and 33 percent in 1992. In those same years the fraction from *Fachhochschulen* was 66, 67, and 63 percent, respectively, while the proportion of engineers who had not completed university or *Fachhochschule* fell from 17 to 5 to 4 percent. Consequently, "the number of good [secondary school] graduates who go through a vocational training in the enterprises to become a *Facharbeiter* and then stay there for long years as skilled workers has dramatically decreased." (pp. 15-16)

Policy makers in Germany and most other industrialised countries have therefore been questioning whether the traditional separation between academic and vocational pathways will remain useful in the emerging economy. Most countries have maintained separate academic and vocational education systems for students after their mid teens. These systems are often housed in separate buildings, follow different curricula, target different students, employ different kinds of teachers, and relate differently to other institutions and actors in society. In Germany, where most teenagers complete apprenticeships, the dual system has been able to maintain high academic standards, and the system is being constantly upgraded, in part to keep more young people from bypassing apprenticeship for higher education. In countries where only a minority of young people participate in vocational training, however, achieving high academic standards on the vocational side is more difficult.

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[16] Jeff King suggests that the real issue here is not the number of vocational specialties, but "the question of how specific is 'specific' for an occupational training category. And if this is the real issue, as I think it is, then we need to find ways of talking about [it] which do not overlook the considerable synergies of higher order knowledge and cognitive skills, not to mention base knowledge in math, science, and literacies (including foreign languages) built into well constructed technical training categories in lead country apprenticeship programs, where six years of a foreign language and several years of comparative religion and political science and economics at the US community college level at least are the property of virtually all apprentices, even in hairdressing or auto repair."

One of the great pedagogical advantages of vocational education is that it often includes learning by doing that enables students to apply the concepts they are studying. But as the rate of technological change has continued to increase and the organisation of work has become more unstable, the specific procedural skills imparted by vocational training risk becoming irrelevant. At the same time, academic education emphasises more abstract theory and general analytic skills which should have more enduring value. Traditional methods of teaching, however, often leave graduates unable to apply their knowledge in a practical context (Resnick 1987). Both academic and vocational education in their traditional forms therefore have certain strengths, but they are insufficient by themselves to prepare students for careers that will require continual learning in the context of work. In Germany, the dual system—linking schools with employers—provides a framework in which it is possible to combine the advantages of academic and vocational education. In countries that rely mainly on schools to provide vocational education, new initiatives have been designed in response to this challenge.

To inform the development of policy and practice in the United States, this report describes the apparent convergence of policies in industrialised countries toward four principles:

- New curricula should be created that integrate academic and vocational studies.
- Occupational and educational performance standards should be explicitly related to each other.
- To prepare for learning-intensive work, initial education and training should include a certain amount of work-based learning for all students.
- Employers and educators, including both academic and vocational educators, must share both responsibility and power in new school-to-work systems.

From the perspective of US policy, the first principle is the most fundamental because it affects how the other three are implemented. Work-based education, skill standards, and employer involvement in education and training can all be achieved in a system that still preserves a sharp distinction between academic and vocational pathways. Therefore, in considering new policies to promote skill standards and work-based learning, it is crucial to ask whether they are being developed in a way that promotes continued divisions between vocational and academic education or, in contrast, promotes education more appropriate for learning-intensive work.

The next section of this report describes in more detail how work is becoming more learning-intensive. Some of the measures taken in several countries to integrate academic and vocational education are then summarised in Section III. Three components that are considered important in successful school-to-work systems are elaborated in Sections IV VI: skill standards that reinforce rather than conflict with the integration of academic and vocational education; work-based learning that is well co-ordinated with academic and vocational instruction in school; and emerging educational governance strategies that share power between employers and educators. Special attention is given to whether these components have been used in conjunction with efforts to bring academic and vocational education closer together. Section VII adds a concluding note.

II. Learning-Intensive Production

Increasingly rapid mobility of information and capital is forcing firms to become ever more nimble. Constant change within organisations and mobility of workers among firms require everyone to keep learning all the time. Learning includes the transfer of existing information, knowledge, and skill from those who have them to those who need them. It also includes the discovery of previously unknown facts and principles, both to improve current routines and to handle new problems. Within firms, the accumulation of many small new discoveries is vital to the continuous improvement of products, services, and methods of production. This is a knowledge-based economy. More importantly, it is learning-based, because the success of companies and individuals depends especially on how fast new information can be acquired and assimilated.

More rapid change in markets and technologies makes it relatively more efficient to locate the creation and acquisition of productive knowledge close to the actual productive process. When knowledge and skill related to equipment, software, and operating procedures are developed outside the work situation, they are increasingly likely to be obsolete before they can be put to use. Growing evidence points to the cost-effectiveness of work-based compared to school-based training (Middleton et al., 1993; Elias et al. 1994). In particular, the work site is the best place to generate ideas about continuous, incremental improvement in working methods. For these reasons, firms and schools alike are displaying greater interest in how work itself generates productive competence (Lave and Wenger 1991; Berryman and Bailey 1992).

When business firms operate in competitive markets without institutional supports for training, they tend to view training as an expense to be minimised. Employers would generally prefer to hire ready-trained workers—or buy or affiliate with another company that possesses the desired expertise—than provide the training themselves. Institutional structures that overcome these tendencies are the dual system for initial vocational training in German-speaking countries, the French system for continuing staff development, and the Japanese system of long-term employment contracts for core employees. In each of these cases special economic incentives have been created to override individual firms' reluctance to provide training (Soskice, 1994; Berton et al. 1991; Koike 1988).

A basic reason why firms generally prefer to minimise their outlay for training is that they lose their investment when employees leave (Becker, 1964; Stern and Ritzen, 1991; Lynch, 1994). Increasing mobility of employees among firms should therefore tend to strengthen employers' reluctance to offer training.

On the other hand, the more rapid obsolescence of work related knowledge and skill makes it more difficult for employers to find exactly what they need on the open market. They must somehow develop it themselves. Furthermore, as firms offer less employment security, they may try to compete for the most qualified people by offering instead greater "opportunity for self improvement" on the job (*Business Week*, October 17, 1994 p. 43). The opportunity to acquire skill and knowledge that may be useful in a future job becomes more valuable for employees as there is less assurance of remaining with the current employer for a long time. A good case in point is the temporary staffing business itself. One firm that has grown as a direct result of the trend toward more short term employment is Manpower, Inc., which in 1992 employed a larger number of people than any other US company. Manpower, Inc. provides temporary staffing to other companies and has created a highly structured method for enabling its employees to consolidate and develop their skills and knowledge as they move from one assignment to another (Seavey and Kazis, 1994).

In the absence of institutional structures or incentives that support training, the main strategy enterprises can use to minimise their training cost and at the same time promote employee development is *on-line learning*. This means acquiring skill or knowledge at one's regular work station and in conjunction with the regular work process, instead of through classes or instructional activities at a different location. Learning that is embedded in the work process inherently entails less opportunity cost than learning off-line. Like just in time inventory control, on-line learning avoids unnecessary investment and minimises deterioration of knowledge and skill from non use. The need to solve an immediate problem also provides both a motivation to learn and a context that makes new information meaningful.

Firms are developing new practices to promote on-line learning. There is no systematic evidence about which arrangements are most effective, but some of the emerging practices can be described as follows:

Cross training by co-workers involves creating teams of workers with complementary skills and knowledge, who teach one another. Such arrangements have become commonplace in manufacturing, spurred by the diffusion of the Japanese model of "lean production" (Womack et al. 1990). Firms in service industries are also increasingly organising employees into teams and encouraging members to share knowledge and information. For example, customer service representatives who formerly carried out highly fragmented tasks are now more often grouped into teams with responsibility for a broader range of functions. The reorganisation requires team members to train one another in their respective specialties. One insurance company has created a written list of all the separate tasks a team should perform and pays individual team members additional salary if they master more of these tasks; managers have observed that employees now use idle moments to exchange work-related information instead of talking about other things (Brown et al. 1993).

Job rotation gives individuals an opportunity to broaden or deepen their skills through exposure to a planned sequence of tasks. This is a hallmark of human resource development in Japanese firms where employees normally remain with the same employer for a long time (Koike and Inoki 1990). The long career in one firm makes it possible to broaden knowledge and deepen skill by moving workers through a sequence of related jobs over the course of many years. It is not unusual to find, among the information posted in a work area, a chart displaying the level of competence of each worker in performing the jobs done there and a plan for the next set of assignments designed to increase everyone's competence.

Skill-based pay or pay for knowledge is a major departure from traditional practice in Europe or North America. Standard compensation practice makes an individual's pay for a given period depend on the job classification to which the person was assigned. Skill-based pay adds a salary increment that depends on the individual's demonstrated mastery of certain knowledge or skills, independent of the job actually performed during the pay period. To the extent that salary depends on competence rather than position, employees become more willing, even eager, to accept reassignment to different jobs. A survey in the US by Osterman (1994) found that 30 percent of establishments awarded skill-based pay to at least some of their employees. This is remarkable given that the idea was unknown in the US until the early 1970s. The principle that pay follows the person, not the job, is also a feature of the compensation system in large Japanese companies.

Formal or informal groups (e.g., quality circles) may be created to discuss problems, develop new procedures, or codify current knowledge or skill. These are well-known as a method for involving employees in solving problems related to quality and efficiency (Cole 1989; Applebaum and Batt 1994). In France, small groups of workers in newly emerging jobs have been formed for the purpose of writing down the knowledge and skill required (Barbier et al. 1992). An additional effect of these group activities is to keep employees' minds engaged in thinking about what they are doing, a basic prerequisite for learning.

Suggestion systems reward the contribution of ideas by groups or individuals to improve products or work processes. Incentives may be provided for continual discovery of problems and solutions. Like quality circles, suggestion systems help to engage workers' minds even if the work itself is largely repetitive. Along with quality circles, suggestion systems are used extensively in Japanese firms, some of which elicit an average of one or two suggestions per employee per week; workers are paid a small amount of money for each suggestion, and a larger amount if the suggestion has substantial value to the company.

Off-line training may incorporate "doing by learning" (Stern 1992a). That is, problems originating in the work itself are analysed in the course of classroom instruction resulting in ideas for solutions that can be implemented in the work setting. For example, a class may introduce the concept of cycle time or five-step problem-solving, then ask participants to apply the concept to real problems in their own work. The benefit of on-line learning is achieved by bringing the work process into the classroom.

Certain employees may be designated as mentors or tutors for co-workers. This role has been formally developed to the greatest extent in German initial vocational education where an apprentice must be supervised by a qualified *Meister*. The French have also created the role of *tuteur*, who supervises young trainees in the workplace (Brochier et al. 1990) or who guides regular employees through the requirements to obtain a vocational qualification (Kirsch 1990).

Written analysis of work problems may be assigned as a condition for promotion or advancement. This is another common practice in Japan where candidates for promotion may be asked to write a 20 to 50 page paper proposing a solution to a particular problem or a set of improvements to current methods. The higher the position, the more substantial the essay.

Job aids may be provided in such forms as computerised "help" menus, data bases, and expert systems. The spread of computers in workplaces has made it possible to replace printed manuals, which are clumsy to update, with on-line help functions that can be updated continuously (US Congress, Office of Technology Assessment 1990). From computer controlled machining to health care to banking, computer application software, data bases, and expert systems increasingly offer on-the-spot guidance and information for workers.

Groups or networks may link different workplaces with similar problems. Billboards and list servers on computer networks provide the means for fast exchange of information. Potentially, this could be an important tool for communicating solutions to problems in different workplaces. However, such communication may be blocked by companies' proprietary interests.

To the extent that on-line learning results in workers becoming more interchangeable and easier to replace, it would increase the bargaining power of employers relative to employees. On the other hand, to the extent that opportunities for additional learning at work are associated with increased reliance on staff members' intellectual contributions, the balance of power shifts in favour of employees. This is reflected in several of the practices described above, including problem solving groups and systems that reward workers who propose significant new ideas.

Because firms must continually seek improvements in their products, services, and methods of operation, staff are increasingly expected not only to adapt to change but also to initiate it by proposing their own ideas. Increasingly, employers must rely on ideas offered by employees. But what kind of incentive can elicit significant new ideas? Coercion is out of the question. Monetary rewards can induce people to submit large numbers of written suggestions, but the Japanese experience indicates that the changes proposed tend to be tiny. Bigger ideas arise only out of genuine interest. The parent of creativity is curiosity.

III. Integrating Academic and Vocational Education

To prepare individuals for work that demands autonomy and continual learning, many employers now call for education that promotes high-level thinking skills for all students, not just for the elite as in the past. Vocational education, which traditionally has offered practical training for students who were considered to possess relatively low academic ability, is now being reformed and in some places radically reconstituted. Reforms include strengthening the academic content of vocational classes and making it easier for vocational graduates to pursue further studies at the university level. These changes are intended to attract more intellectually talented students into vocational programs, to give them sufficient theoretical grounding to deal with changing technology, and to prepare them for continual problem solving. As change proceeds in this direction, the line between vocational and academic education becomes indistinct. Instead of serving as an alternative to general education, vocational education becomes a method for promoting it. At the same time, the teaching of academic subjects in many countries is moving toward more active pedagogy that often features production of student projects, though these are not necessarily related to present or future employment. The trend toward convergence of vocational and academic education mirrors the growing interconnection between production and learning in the workplace.

Developments along these lines are occurring in all major industrialised countries. For a basic description of the vocational and general educational systems in the G 7 countries, see Medrich, Kagehiro, and Houser (1994). Here the focus is on recent changes to the existing structure.

Japan unveiled a new "integrated" vocational academic high school course in 1994 (Japanese Ministry of Education, Science, and Culture, 1995, pp. 47 52). Until then, Japanese high schools offered either a prescribed general curriculum as preparation for university or a specialised vocational curriculum. The proportion of students attending vocational high schools fell from 40 percent in 1955 and 1965 to 26 percent in 1992. Therefore, beginning in 1994 high schools were permitted to offer an "integrated" curriculum focusing on career development. Students in the integrated programme have fewer required subjects and are given career guidance to help them design their own course sequence. As of 1994, only seven schools had introduced the integrated curriculum but it was expected that the idea would catch on and promote "convergence of vocational and general education" (Yoshimoto 1994 p. 5). This convergence already has occurred to some extent at the post secondary level through the growth of special training colleges offering higher diplomas in industrial, commercial, and other vocational fields. Enrolment in these institutions stood at 862,000 in 1992, double the number in 1978, and more than one third the 1992 enrolment level in universities.

France has created an array of upper secondary diplomas: general, technical, and vocational. Around age fifteen, after four years of lower secondary school, most students either continue in a three-year upper secondary programme toward a general or technical diploma or enter a two-year vocational program. The vocational diploma was first introduced in 1985 to give graduates of two year vocational programmes an option to receive an upper secondary diploma after an additional two years. As of 1991–92 the number of students enrolled for the vocational diploma had grown to 114,000 compared to 707,000 preparing for general and 290,000 for technical diplomas (Kirsch 1994).

French students holding a secondary diploma can pursue further vocational education in several ways. Secondary schools themselves offer programmes leading to higher technician diplomas. Two-year technical institutes within the universities also offer technical diplomas. The university technical institutes were created after uprisings in 1968 to give working-class students access to the university. Until the late 1980s, most graduates entered the work force. However, the recession of the early 1990s has made it more difficult to find good jobs and larger numbers of university technical graduates have been continuing their studies at the university. This has caused some problems with university professors protesting that the application-oriented curriculum of the technical institutes does not provide sufficient theoretical preparation. At the same time, the two-year technical institutes are trying to add a third year which would purportedly be spent mainly in workplaces, thus encouraging graduates to enter employment. The controversy over the French university technical institutes reflects one of the dilemmas in combining academic and vocational education: if the academic content is rigorous enough to attract academically talented students, the vocational mission of the programme may be forgotten. This dilemma may arise again in connection with new four-year university professional institutes that have been created to give another point of entry to the labour market at a still higher level of the educational system.

Norway introduced a comprehensive reform of its upper-secondary education in 1994. The three-year sequence starts with a common core curriculum in the first year, then offers choices for increasing specialisation in the next two years, with considerable work-based learning in the third year. Students who complete a vocational sequence but then decide to go on to university may do so after completing one additional year of study.

In *Germany*, as discussed in Section I, the dual system of apprenticeship is widely regarded as a successful model for initial vocational education (see also Hamilton 1990). A series of studies in the 1980s pointed to the effectiveness of German training, in particular as compared to training in Britain (Daly et al. 1985; Steedman and Wagner 1987, 1989; Prais et al. 1989). These studies found that German firms in certain manufacturing and service industries were more productive than similar firms in Britain. After carefully observing the production process, and taking into account any differences in the quality of equipment, the researchers concluded that the level of skill acquired by German workers in their initial training seemed to explain much of the difference in workplace productivity. For example, German mechanics were better able to keep equipment operating because they knew more engineering than their British counterparts.

Imparting a high level of theoretical and academic knowledge is an important goal of the German dual system. Soskice (1994) points out that employers encourage academic achievement by awarding the more sought-after apprenticeship positions to students who have performed better in school. In recent years the school-based portion of apprenticeship training in most of the German states has begun to include a critical analysis of technology, so that students are better prepared to participate in the "active shaping" of technology and work. A greater amount of time has also been set aside for teaching general academic subjects. Hermann Schmidt, President of the Bundesinstitut fur Berufsbildung (BiBB), which oversees the apprenticeship system, has declared that "the separation between general and vocational education is becoming obsolete" (Schmidt 1994, p. 9).

Traditionally, the separation between the pathways of apprenticeship and university has been clear: students who attended a gymnasium and received the Abitur diploma went to university, while the others entered apprenticeship. However, in recent years a growing number of Abitur holders are completing apprenticeships prior to entering university. Rauner (1995) reports that the proportion of university students who had completed apprenticeships grew from 21 percent in 1985 to 30 percent in 1994. Evidently these students have decided they want even more theoretical and academic preparation than the dual system provides. One reason, already noted in Section I, is that some employers are reportedly turning to universities and polytechnics (*Fachhochschulen*) to supply high level employees. Steedman (1993) observes

> a relatively new phenomenon, the difficulty being experienced even by the most prestigious engineering firms in recruiting trainees of the necessary high ability and aptitude. Respected commentators... have, as a result, diagnosed a crisis of the whole [apprenticeship] system arguing that if

> the high-cost high-quality training provision of the prestigious industrial companies is discontinued in favour of recruitment from higher education, then the credibility of the system as a whole will be undermined. (p. 1288)

Although Steedman herself concludes that the dual system is still strongly supported in Germany, policy makers are concerned that if large numbers of high-achieving students begin to view higher education as a better path to work than apprenticeship, the dual system might deteriorate. To prevent students' demand for university education from undermining the dual system, "The social partners share the view that the transition to higher education institutions and universities should also be ensured or at least made easier for graduates of the dual system," according to a senior official in the BiBB (Laur-Ernst 1992, p. 40).[17]

The *United Kingdom* is in the process of introducing a new set of vocational qualifications called General National Vocational Qualifications (GNVQs). At the advanced level, these are intended to be the vocational equivalent of academic "A level" examinations, which are required for entrance to university. GNVQ courses are currently offered or planned in fourteen fields, including art and design, business, construction and the built environment, engineering, health and social care, leisure and tourism, manufacturing, hospitality and catering, information technology, and science. The government is encouraging all institutions of higher education to accept GNVQs in combination with or instead of A levels. The 1991 White Paper on "Education and Training for the 21st Century" which inaugurated the new programme declared, "The government wants to remove the remaining barriers to equal status between the so called academic and vocational routes." (paragraph 4.2)

The first year in which students completed advanced GNVQs was 1994. In that year, 772 applied for admission to higher education, and 85.3 percent received at least one offer (UCAS, 1996). In 1995, the number grew to 8,525, and 89.1 percent received offers. UCAS, the clearinghouse for applications to institutions of higher education in Britain, reported that 91.6 percent of the 19,353 GNVQ holders who applied in 1996 received at least one offer of admission, compared to 88.4 percent of the total 379,582 applying for admission to higher education. The GNVQ field accounting for the largest number of applicants in 1996 was business, with 10,223 applicants, of whom 96 percent received at least one offer. Another 3,010 applicants held advanced GNVQs in leisure and tourism; 93 percent of these received offers. Of the 2,674 applicants who held advanced GNVQs in health and social care, 77 percent won offers. No other field accounted for more than 1,000 applicants in 1996. These figures indicate that the GNVQ has become an accepted route to higher education.

While the social demand for higher education in other industrialised countries is giving rise to policies that attempt to preserve vocational education by linking it to the university, the pressure for universal access to higher education is even greater in the United States. Conceived in revolt against monarchy and the feudal aristocracy that went with it, this country has traditionally placed great value on equality of educational opportunity. In fact, the proportion of young adults who complete a bachelor's degree or more (including master's, which is the first higher education degree in several countries) is higher in the United States than in any other OECD country except Canada (OECD 1995a, p. 219). A high school graduate may decide not to go to a four-year college or university right away, but keeping the option open for the future is considered important in case a person wants to change careers or is forced to do so. Including college-bound students in career preparation programmes also prevents the programmes from being stigmatised as second-best.

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[17] Jeff King notes that "the increased access to and use of the polytechnics and *Fachhochschulen* by skilled workers up-grading skills and qualifications beyond Technician or *Facharbeiter* levels means that firms and workers can either alternate work and higher education or pursue both simultaneously through evening and weekend degree programs..., thus reducing the appeal of pure recruitment from higher education alone."

The clarification of this commitment in US policy can be seen in the evolution from the 1990 Perkins Act to the 1994 School-to-Work Opportunities Act. The 1990 Perkins Act mandated academic-vocational curricular integration and also provided support for "tech prep" programs, which link the last two years of secondary school with the first two years of post secondary education (Hull and Parnell 1991). The School-to-Work Opportunities Act repeated the appeal for curricular integration, called for the addition of work-based learning, and also urged the linking of secondary to post secondary education, including not only two year colleges and technical institutes but four year colleges and universities.

Grubb (1995) provides examples of various approaches to high school reform that combine academic and vocational curriculum and prepare students for both careers and college. Stern et al. (1995) report evidence that such approaches have improved students' performance in school. *Business Week* magazine (1996) has published descriptions of ten "new American high schools" that use integrated academic-vocational curriculum as the basis for whole-school reform. The National Association of Secondary School Principals has endorsed this strategy in a statement written with Jobs for the Future (1995). The National Council of Teachers of Mathematics, and the National Science Teachers Association, have both published curriculum standards that emphasise the value of understanding in a practical context. Many schools are using the study of technology to teach theoretical concepts in mathematics and science (Raizen et al., 1995). The National Centre on Education and the Economy (1995) has published suggested standards for student performance that weave "applied learning" together with English, mathematics, and science; examples of actual students' work from various school districts is included. These and other initiatives indicate widespread interest in blending the academic and vocational curriculum so that students are prepared for both college and careers.

The dichotomy between vocational and academic will not disappear quickly or without struggle, since the old disciplines have long been entrenched and there is a strong tradition, especially in Europe but also in the United States, of using secondary education to sort students into various levels of the occupational hierarchy. But pressure is growing to create something new because work increasingly requires continual learning and it is becoming more difficult to attract talented or ambitious students to traditional vocational education. Fundamental change may take years or decades, but the pressure is being felt throughout the industrialised world, and educational authorities are responding.

IV. Skill Standards

Industry based skill standards play an important role in the school-to-work education system articulated in the School-to-Work Opportunities Act. Policy makers, education reformers, and analysts argue that a well functioning system of standards will have many positive benefits. Standards tell students what they need to know to enter a particular occupation; indicate to employers the skills and abilities of applicants; facilitate the assessment of educational institutions; and, perhaps most important, provide a forum for employers and schools to work together.

There are two important points concerning the history and development of standards in the United States. First, skill standards in this country are not new. Over the last few decades, states and occupational groups have developed a plethora of systems for setting standards and assessing skills. Nevertheless, contemporary standards advocates see the current reform movement, which will be co-ordinated by the National Skill Standards Board, established by the Goals 2000: Educate America Act of 1994, as a significant break from these disparate and uncoordinated past systems, because it is hoped that the new standards will be adopted nation-wide and thus maximise portability within the United States. Second, the emerging interest in standards during the last few years is very much linked to perceptions about the changing workplace based on the increasing importance of "learning-intensive" work which focuses on the application of more general, traditionally academic skills to the workplace. Given the current emphasis on broad-based workplace skills, the adoption of skill standards should reinforce the integration of vocational and academic education.

To what extent have current skill standards efforts in the *United States* promoted greater integration of academic, vocational, and generic skills? On the one hand, at least through the middle of the 1990s, the movements to develop academic and industry-based skill standards have been developed independently with little interaction between individuals involved in the two movements. The National Skill Standards Board has a very strong industry focus, as it was designed to have, and, so far, educators have not been significantly involved with many of the skill standards pilot projects funded by the Departments of Labour and Education to develop models and practice. The majority of these skill standards models still conceptualise academic and vocational skills separately (Bailey and Merritt 1995).

On the other hand, some of the skill standard pilot programmes have attempted to integrate academic and occupational skills. The New Standards Project of the National Centre on Education and the Economy in collaboration with LRDC has contributed to the formulation of integrated standards. Two trends in the design of standards systems suggest progress, and both of these trends are strongly endorsed by the National Skills Standards Board. The first involves the attempts to incorporate generic workplace skills such as problem solving and teamwork (SCANS skills) into the systems of standards. While the use of SCANS skills is not the same as a comprehensive attempt to integrate academic and vocational education, it does move beyond a specific focus on narrowly defined vocational skills. Although most of the skill standards pilot projects are still trying to determine how to incorporate generic skills into their

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systems, there is little disagreement that it is necessary. The second trend that moves education away from narrowly defined occupational skills is based on broadening the definition of the occupations. In some, although certainly not all of the pilot projects, designers have tried to set standards for broad occupational clusters instead of narrower occupations.[18]

The goal of a contemporary standards movement cannot be simply to set recognisable standards. After all, the United States already has extensive experience with occupational and professional standards, though these are often set by individual states and not recognised nationally. Rather, standards must be seen in the context of a broader education reform movement. Industry skill standards can easily solidify past practices. This can be true even if standards have many characteristics called for by reformers such as portability, national recognition, modularisation, and development through intensive employer input. This section considers some of the experience in other industrialised countries with using standards to promote the stronger integration of academic and vocational education.

The great strides that *Australia* has made in improving its vocational education and certification process have centred around broadening vocational credentials. Indeed, major elements of the country's training reform agenda involve improving the efficiency and output of vocational education, making it more acceptable and relevant to high performance industry needs.

Competency-based training (CBT) is a quality assurance system concerned primarily with training, assessment, and credentialing to meet industry specific standards. The Vocational Education, Employment and Training Committee has defined the key features of the Australian competency-based training system:

> Essential aspects of a CBT (competency-based training) system are that delivery, assessment and certification of training should relate to the identification of, instruction in, and demonstrated attainment of the knowledge, skills, and applications required for effective performance at the required level, as defined in competency standards (OECD: Australia 1992: 10)

Competency-based training and assessment are essential features of the Australian Vocational Certificate Training System. The new national framework for defining occupational standards includes the Australian Standards Framework, which defines eight competency levels that apply to all industries (from entry-level to bachelor's degree level) and the National Training Board, which works in consultation with industry to endorse national competency standards. For more than twenty broadly defined industries, such as metals and engineering, building and construction, and so on, Industry Training Boards or

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[18] Jeff King notes that "the question of integration of academic and vocational skills seems to turn on related issues of connecting 'generic skills' to 'occupational skills'. And perhaps so. But what does not seem to be considered ... is the *possibility that generic skills may themselves be a product of contextualized learning within occupational categories*, both those which are 'narrow'—if deep enough also—and those which represent 'broad occupational clusters.' (Cognitive returns to scale issues again [see note 5 above]). ... Must it be the case that deep training in technical specialties necessarily forecloses 'generic' skills? What if the technical specialty is itself based on very broad and deep learning in basic arts and sciences disciplines—math, science, comprehensive literacies, etc.—as well as technical specialties both using and advancing the subtlety of this basic knowledge? It seems to be an underlying assumption here that technical training in occupations cannot do this. But it can...."

Industry Training Councils have been created. These bodies have been asked to define standards to "ensure that work force entrants are equipped with both the key competencies and specific industry and occupational competencies." (OECD: Australia 1994, p. 2)

The competencies defined are of two kinds: "key competencies," which show a striking resemblance to SCANS skills in the United States; and "functional competencies," which deal with employment-related skills in work force preparation programs. Functional competencies include aspects of the key competencies, but they also include industry-specific skills, and they are written in industry-specific terms (Bishop, McDonald, and Manidis 1994). Australia's reforms seek to incorporate key competencies into entry-level training courses for all young people regardless of their chosen career path (OECD: Australia 1994).

Education and training portfolios have been integrated by the Ministers for Vocational Education, Employment and Training (MOVEET) so that vocational competency standards will be formally linked to vocational curriculum and its accreditation to form more solid pathways for students. It is now broadly accepted that traineeship and apprenticeship systems should be brought together under a common framework that integrates the Vocational Education and Training (VET) curriculum taught in secondary schools with the post secondary Technical and Further Education (TAFE) institutions. MOVEET agreed to move toward a new, unified entry-level system incorporating and expanding upon the apprenticeship and traineeship systems and their qualifications (Noonan 1994).

Efforts to integrate, both conceptually and structurally, employer-based training with training located in schools and colleges have led to an easier articulation and transfer of credits across vocational institutions. By agreeing to a series of assessment principles and processes that minimise the importance of where and when training takes place, training undertaken at work and previous knowledge and skills are now recognised and allowed to serve as the basis for the achievement of publicly accredited qualifications and competency standards. Not only does this affect worker credentialing, but the designers of curriculum now have greater latitude to modularise training in various ways leading to formal qualifications (Noonan 1994).

Australia has made important progress toward reforming its system of vocational standards. This has promoted integration among vocational, academic, and generic skills in various vocational institutions and between secondary vocational education and post-secondary technical education. At the same time, this new system has influenced the academic high school curriculum in every state (Keating 1995). Fifteen years ago, Australia's high schools were largely academic institutions, focusing primarily on preparing students for university entrance examinations (Vickers 1991). Only one-third of each youth cohort graduated from high school, while the remainder left school at the end of eleventh or twelfth grade to enter vocational training programmes in TAFE colleges or to enter the work force. The only students who graduated from high school were those who completed a full programme of academic subjects and passed the matriculating examinations (Vickers 1991, 1995a). Today, Australia's high school graduation rates are equivalent to those in the US, and there has been a revolution in the content of high school curriculum. Key competencies (equivalent to SCANS skills in the US). are being incorporated into upper-secondary school courses in every state (Keating, 1995). A wide range of new, occupationally-oriented courses have been developed and introduced into the high schools, and in some cases, students are studying TAFE college courses while still in secondary school. Because Australia's national system of vocational standards is now in place, many of the new curricula being developed by the states conform to those standards. Many high school students now gain a nationally-recognised occupational credential when they graduate from high school, and these credentials are recognised by the TAFE colleges (Australia: NBEET 1994).

However, there are inevitable tensions between the norms and values of the academic and vocational education systems, and a recognition that it would be difficult to achieve a complete integration of the two. For example, while occupational credentials gained at high school are recognised by TAFE colleges, university admissions authorities tend to place more emphasis on success in academic subjects. Recognising the inherent difficulties in unifying the two systems, Australia's planners have stated that it is their intention to integrate academic and vocational education "to the extent this is feasible" (OECD: Australia 1992, p. 19).

Policy makers in *England* and *Scotland* have explicitly tried to develop two parallel but equal educational streams, one academic and one vocational. The development of the vocational stream has been keyed on assessments designed to promote the integration of academic and vocational education through General National Vocational Qualifications (GNVQs) in England and Wales, and Scottish National Vocational Qualifications (SNVQs) in Scotland. These reforms have many positive elements, although there are some limitations. The role of the GNVQs can best be understood in contrast to the National Vocational Qualifications (NVQs) which were established in 1986. The NVQs are comprised of specific work-related competencies established by industry groups (lead bodies) and assessed in the workplace. They are designed to measure and certify the ability to carry out specific workplace functions (although these could be highly complex) and to be independent from educational institutions, thus allowing for the certification of skills that are acquired purely on the job or in other non-school settings (OECD: United Kingdom, 1994).

The NVQ system has many critics. While NVQs prepare students for particular jobs and occupations, critics argue that they are too specifically task-based. Since the skills involved are specific to industries and not transferable across industries, any general academic skills or knowledge embedded in them is in effect not certified or capable of being formally recognised by other industries. The assessment system is also criticised for not being sufficiently independent, since the employers often both do the training and assess that training (Payne 1995). It is also not clear whether employers have the capacity to train for many of the NVQs (Vickers, 1994). Overall, the NVQ route contrasts sharply with the course of study taken by university-bound students.

At the advanced level, the GNVQs are intended to be equivalent, but still separate, from the academic "A level" examinations required for students seeking admission to university. Thus the GNVQs cover "general" knowledge areas for young people in full-time education. As noted in Section III above, the number of advanced GNVQ holders applying to institutions of higher education has grown rapidly to nearly 20,000 in 1996, and more than 90 percent of these succeeded in winning at least one offer of admission (UCAS 1996). Thus, in contrast to the NVQs, GNVQs are explicitly aimed at encouraging the integration of academic and vocational education and appear to have accomplished their explicit purpose of bridging the separation between academic and vocational streams. While the GNVQs are a bold reform, critics have argued that the GNVQs tend to neglect some of the conceptual and theoretical knowledge that underlies relevant practice. Moreover, there is still a long way to go before the GNVQ system can achieve full parity with the traditional academic route (Payne 1995).

Similar to the English system, the Scottish system has attempted to integrate academic and vocational credentials at the post secondary level through The General Scottish Vocational Qualification (GSVQ).

> Unlike occupational SVQs, GSVQs will not be designed as statements of competence as defined by lead bodies [industry organisations], but will focus on the skills, knowledge, and understanding that underpin a range of SVQs, within a broad occupational area. They will therefore be designed so that the outcomes to be achieved can be developed and assessed in colleges and schools, whilst maintaining an emphasis on application. (OECD: Scotland 1994, p. 5).

GSVQs expose students to a number of related occupations, work-readiness, and general education skills and are developed for young people who either wish to progress into higher education or go immediately into employment, as well as for adult returners. Thus, like the GNVQs in England, the GSVQs represent an attempt to define much broader occupational areas and to introduce some integration of academic and vocational education.

Scotland has a longer history than England of attempts to integrate academic and vocational education and to increase the status of vocational studies. The GSVQs have been built on a broad reform agenda introduced by the 1983 Scottish Action Plan which also tried to bring academic and vocational education closer together. The Plan developed a modular system of vocational qualifications awards with input from both employers and Further Education Colleges (similar to community colleges in the United States). The flexible certificate system which leads to a National Certificate (NC) is available in over 3000 modules (each representing 40 hours of study) and was designed to serve the diverse needs and interests of students and employers. NC modules can be used to meet parts of the high school graduation requirements and can act as stepping stones to advanced level vocational qualifications. This system was aimed, among other objectives, at allowing individuals to mix academic and vocational education; encouraging greater participation in further and higher education (by facilitating credit transfer, progression, and choice); and encouraging active, practical, and student-centred approaches to learning and teaching (OECD: Scotland, 1994, p. 9).

An interesting feature of the Scottish Vocational Qualification framework is the use of modules or units of learning in the National Certificate. Individual modules can be built into group awards similar to occupational or educational clusters, and tailored to meet established national criteria as well as specific employer and student needs. They cover a wide range of subjects including engineering, finance, agriculture, tourism, science, languages, arts, building, and health. The modular or cluster format was also being used in Further Education

Colleges leading to Higher Certificates (higher level academic degrees) and Higher National Diplomas (higher level vocational degrees). These group awards are now forming the basis of the GSVQs.

Although the National Certificate system allows students to combine academic and vocational courses in broad occupational clusters while leaving open the option of higher education, the academic and vocational paths are still divided. Some NC modules had formal equivalence to the academic Highers and were recognised for entrance into university, but there remain two distinct routes to higher education and a persistent disparity in esteem between the academic and vocational credentials (OECD: Scotland 1992, pp. 13-14; OECD: Scotland 1994, p. 12).

As a result of these perceived deficiencies, Scotland is introducing another series of reforms for higher level secondary education. These reforms are designed to strengthen the links between academic and vocational education; increase the vocational content of academic studies and the academic content of vocational studies; and reduce further the contrast in status. In the last years of secondary school courses students following the traditional academic route (overseen by the Scottish Examination Board) and those following the vocational route (overseen by the Scottish Vocational Education Council)—including those leading to the General Scottish Vocational Qualification (GSVQ)—will be brought into a unified curriculum and assessment system leading to a restructured secondary school diploma. This will incorporate academic and advanced occupationally related subject matter into a reformed and unified stream. The SVQ system will remain as a separate system for "those [students] for whom Highers are inappropriate." (OECD: Scotland 1994, p. 13). Thus despite widespread attempts to unify the two streams, a credential based lower stream will remain, at least for some students.

In *Denmark*, a growing emphasis on academic rigor in the first year of vocational training, combined with more valid assessments involving employers and educators throughout the learning process "contribute to placing vocational education on an equal footing with other educational disciplines." (Danish Ministry of Education and Research 1992, p. 4) The co-ordination required to maintain continuous dialogue between industry mentors and school-based instructors on pedagogic and assessment issues leads to a greater understanding of vocational credentials among all constituencies, especially employers, and aids in increasing the quality and reputation of vocational education programs.

All vocational education and training courses in Denmark culminate in a "skilled worker certificate" issued by Trade Committees (OECD: Denmark, 1994). As in Germany, the overall educational experience leading up to it represents a solid combination of general, academic and vocational courses.

> A supreme objective of vocational education and training policy in Denmark is to preserve the versatile character of vocational training and to provide genuine opportunities for continued training. The courses must also contribute towards the aim that not only young persons who choose a general upper-secondary education, but also those who choose vocational training in a specific trade should have general education. (OECD: Denmark, 1994, p. 8)

Upper-secondary vocational students now take basic, area, special, and optional subjects in the school portion of their vocational training which are "not solely aimed at acquiring technical and professional competence within a narrow professional framework" (OECD 1994:8). Basic subjects encompassing one third of the school curriculum include practical and theoretical training in traditional academic areas such as language, math, and social studies. These subjects must "provide both technical breadth and enhance personal development; qualify students for further studies; and convey an understanding of society and its development" (Danish Ministry of Education and Research 1992: 3). Area subjects, also one third of the school curriculum, focus on practical and theoretical training for broad occupational fields and provide general as well as specific vocational qualifications. The remaining third of school-based vocational training is divided between special and optional subjects that offer students more specialised and professional training often geared toward particular company needs.

Denmark has established a series of upper secondary vocational training courses leading to graduation through either a higher technical exam (HTX) or a higher commercial exam (HHX) both of which have become valid alternatives to general upper secondary education and contribute to the increasing reputation of vocational education relative to general education. These vocational routes, established by law in 1990, share many structural and content features with general upper secondary school such as theoretical courses in the second and third years (OECD, 1994). Maintaining the Danish goal of educational mobility, they have become an equally valued alternative to general education because they qualify students for admission to higher education as well as employment. Passing these courses allows for admission to university higher education courses, advanced commercial courses and engineering diploma courses. Østerlund (1994) reports that substantial percentages of students in these vocational programmes do transfer back to the university track. While maintaining distinct academic and vocational secondary level credentials, the Danish system increasingly permits students to cross back and forth between the two pathways.

The many strengths of the *German* system have received widespread attention in the US (Hamilton, 1990; Commission on Skills in the American Work force, 1990). At the same time, the German system itself is continuing to evolve as educators and employers in that country try to adapt to changing economic conditions and skill requirements. For example, Rauner (1995, p. 12) argues that the "traditional pragmatism and history of the German occupational structure is certainly not a sufficient basis for a forward-looking professionalisation of occupations." He points out that traditional German occupations and their associated certification tend to be defined by specific technologies, but increasingly rapid changes in technology destabilise the labour market and tend to undermine the associated occupational structures. In contrast, professional occupations such as doctors and engineers, traditionally trained in universities, have maintained a stable culture and identity despite changes in technology. Thus analysts within the German apprenticeship institutions are working toward strengthening the teaching of interdisciplinary and social skills required for self-reliant occupational competence (Federal Institute of Vocational Training 1994, p. 13). These reforms are given impetus by reports, noted in Section I, that employers in some industries who used to recruit through the apprenticeship system have begun hiring university graduates instead, with the result that young Germans perceive a growing advantage of a university relative to a vocational credential (Steedman, 1993; Federal Institute for Vocational Training, 1994; OECD: Germany, 1994; Bailey 1995; Mickler 1996).[19]

As a result of these tensions, the Germans have introduced a number of reforms. One important change has been the dramatic reduction in the number of occupational categories. In 1987, 37 metalworking occupations were replaced by six with much broader profiles of responsibilities (Rauner 1995). While in the past, "generally acknowledged vocational qualifications such as the master craftsman certificate [did] not have significance for admission to a technical college," (Reisse 1992: 16), steps have now been taken to widen the recognition of vocational qualifications. Increasingly, young Germans are also entering universities after completing apprenticeships.

Vocational education reform in the *Netherlands* has assumed two primary objectives over the last several decades. Until the early 1980s, reform efforts were aimed at assuring educational equality and reducing the differences among vocational and general education. These efforts sought to give students ample opportunities to transfer within the system. At that time there was "a heavy emphasis on the principle that vocational education should not be a dead end and that it should offer students at least some of the same opportunities as general education" (Streumer 1994, p. 5). With national economic difficulties arising in the mid and late 1980s, however, the purpose of vocational education reform shifted toward developing a more effective work force preparation mechanism in which the labour market could interact with the educational system to fulfil its labour needs.

At first glance, it appears that these two reform objectives are conflicting and actually work against each other. An industry focus places much of the onus of reform on vocational education to narrow its mission and become an instrument for the fulfilment of specific, sometimes narrow, industry training needs. On the other hand, an emphasis on establishing equality between general and academic education means achieving some middle ground between broadly and narrowly defined educational missions. Many countries forced to deal with this conflict have opted for the former and concentrated on upgrading employment-related and job-specific skills, sometimes giving them a broader focus than vocational education formats have traditionally offered. In the Netherlands the tensions between creating equality among educational paths and catering to industry needs have stimulated changes in both the vocational and general education systems. General and vocational education have moved toward a more symmetric relationship as "complementary parts of a single coherent whole with a common purpose" (Streumer 1994, p. 5).

New national skills standards and a unified qualification structure for vocational education have helped to bring academic and vocational education into a common framework. Efforts to broaden occupational credentials to meet industry needs began in the late 1980s and early 1990s when the Dutch government established a *qualificationnorm* representing the minimum vocational qualification that every Dutch resident must meet in order to function adequately in the labour market and modern society. Agreement was reached that courses in senior vocational secondary education and higher forms of general secondary education would be equal at the *starkwalificatie* or apprenticeship level, forcing changes at both the junior secondary vocational and lower general secondary levels of education (Van den Dool and Wiejs, 1994, p. 6).

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[19] Jeff King suggests a different view. "The problem is not that apprenticeships as a broad system of skills training and certifications are too unlike the professions and show no signs of ever becoming like them. Rather the problem is that the entire system is rapidly moving apprenticeships toward ever high degrees of professionalism, and whether that may eliminate distinctions between apprenticeship trainees and college trained graduates to the extent that lower skilled and lower wage positions begin to lack formal training pathways."

On-the-job training and the practical aspects of education have gained credence in upper-level general as well as vocational education, emphasising not just the broadening of skills but the idea of "professional practice as part of the formal curriculum" (Van den Dool and Weijs 1994, p. 7). Although it is likely that traditional institutional distinctions and hierarchical relationships between vocational and general education will persist in the Netherlands for some time, the gap is beginning to be bridged as university curricula have started to include work-related elements consistent with current labour market requirements. According to Van den Dool and Weijs, "there is a slow shift toward equality of status as the vocational element in university courses is strengthened and the vocational sector is increasingly seen to deliver courses leading to final qualifications of equal value with their university counterparts" (p. 1). A certificate from higher vocational education (HBO) now qualifies students to enter the university (Streumer, 1994).

In summary, it is apparent that standards and certification processes are important vehicles for system-wide reform and innovation in many OECD countries. There has been a general movement to consolidate the numbers of particular occupations for which credentials are awarded and to incorporate generic workplace skills into standards systems. But these changes can occur without challenging the distinction between academic and vocational streams of education.

In addition, a growing number of countries are developing vocational credentials that can serve as stepping stones to university and other forms of higher education. The advanced GVNQ appears to have become established as a viable route to higher education in England. Scotland is developing a unified secondary credential. Germany, the Netherlands and Denmark have all opened more avenues to universities for holders of vocational qualifications. In Australia, the development of new vocational standards has influenced the content of traditional academic secondary school education. By combining academic and vocational content, new standards and credentials open students' options for both employment and continued education.

V. Work-Based Learning for Students

Because one hallmark of the emerging economy is the necessity for continual learning in the context of work, a logical implication for initial education and training is that schools should give young people some experience in work-based learning. By gaining practice in the deliberate use of work to develop knowledge and skill, young people should be better prepared for a lifetime of on-line learning at work. Some evidence that inclusion of work site learning as part of initial education does have this effect is presented by Romani and Werquin (1995). They find that young people in France who have participated in work-based learning during their initial education are more likely to engage in continuing training as part of their subsequent employment. Romani and Werquin hypothesise that early participation in work-based learning may start a lifelong habit.

In addition to this possible future benefit, work-based learning has immediate advantages as an efficient method for acquiring knowledge and skill. Evidence on the cost-effectiveness of work based compared to school-based training has already been mentioned (Middleton et al. 1993; Elias et al. 1994). The educational benefit of work experience may also extend beyond the knowledge and skill that are strictly related to work (Berryman 1995). As vocational and academic education converge, work-based learning may help students better understand abstract, theoretical ideas by applying them in concrete, practical situations.

The advantages of learning by doing have long been recognised, but lately the opportunity for young people to learn through regular employment has diminished in some countries. Payne (1995) describes the sudden, dramatic shift from work based to school-based vocational training in the United Kingdom between 1988 and 1992. Sweet (1995) presents evidence of the recent decline in teenage employment in Australia. The recession of the 1990s pushed young people out of work in Sweden and France, as indicated in Figure 4 above. In Denmark, the recession brought a shortage of places for apprentices in business enterprises.

Policy makers in many countries have responded to the contraction of youth employment and the perceived importance of productive experience by creating new mechanisms and incentives to promote work-based learning. These initiatives take two main forms: classic apprenticeship or work experience tied to schooling. The basic difference is that classic apprenticeship treats trainees as members of the enterprise, giving them some of the rights and benefits of regular employees as well as some special entitlements. For example, German apprentices receive health and retirement benefits; benefit from special protection against firing; and receive special attention from their instructors (*meisters*). In contrast, young people who participate in work-based learning that is part of their schooling are still primarily students even though they may be paid for their part-time work.

A good example of a recent policy to reinvigorate classic apprenticeship is the initiative in the *United Kingdom* to create "modern apprenticeships" for 16 17 year old school leavers. These youth receive government-funded training credits which they can cash in with employers who are able to provide the training required. Unlike traditional apprenticeships, these new arrangements will not require trainees to spend a fixed length of time in the enterprise. Instead, qualifications will be awarded when the apprentice has passed a set of performance based requirements (the NVQs discussed in Section IV). Prototype programmes were developed in 1994 in 12 sectors including agriculture and commercial horticulture, business administration, chemicals, child care, construction engineering, information technology, and retailing. When the new system is fully up and running, there are expected to be 150,000 apprentices in training (U.K. Employment Department, 1994). This number equals roughly 10 percent of the age group.

Other countries are also reviving traditional apprenticeship. *Spain* passed a new apprenticeship law in 1994 (Planas 1995). In the *Netherlands*, Streumer (1995) reports that the number of apprentices grew by 50 percent between 1986 and 1992. The government of *Australia* has announced plans to introduce a Modern Australian Apprenticeship and Training System, with many of the same features as the new U.K. system.

While some countries are enlarging opportunities for work-based learning through classic apprenticeship, many other countries are developing new forms of work-based learning for students who do not receive the full rights and benefits of regular employees in the firms that train them. Most of the new efforts to develop "youth apprenticeship" in the United States, along with other forms of work-based learning encouraged by the 1994 School-to-Work Opportunities Act, belong in this category. Within this category of school-supervised work experience, some are attached to separate vocational programs, but others are connected with programmes that combine vocational and academic instruction. Within the United States, co-operative education is still the most common form of work-based learning for high school students, and it is usually part of a vocational programme (Stern et al., 1995). Most of the examples in other countries are also of this kind.

Korea, for example, restructured its three-year vocational high school curriculum in 1992 to include one full year in enterprises. This was intended to attract more students into vocational high schools, and to enhance their adaptability in actual work situations (Cho, 1994). Recent measures to enlarge the opportunities for vocational high school graduates to enter university also serve to increase the attractiveness of the vocational program.

Similarly, *France* is making greater use of unpaid internships (*alternance*) for vocational students. This began on an extensive scale with the introduction of the vocational secondary diploma (*bac professionnel*) in 1985, followed by a 1989 law that required students enrolled for vocational or technical diplomas to spend some time in workplaces. For the vocational diploma, the requirement is at least 16 weeks in enterprises during the two year program. However, "The difficulty was to convince the companies, given that they would not be ... [the ones to initiate] this *alternance*, which is tied to the needs of training rather than employment" (OECD 1994, p. 118). Nonetheless, the fact that hundreds of thousands of vocational diploma students have in fact been placed in enterprises has encouraged the educational authorities in 1992 to extend the practice to the two year vocational programmes that start at age 15 and precede with the vocational diploma program. The university technical institutes are also in the process of adding a third year which will consist mainly of firm-based traineeships.

In *Australia*, where the proportion of students completing the last two years of secondary education has jumped from one third to three quarters in a decade, governments and private entities are working fast to augment the traditional academic curriculum with more practical applications. Sweet (1995) reports that the number of Australian students enrolled in courses with a centrally recognised work based component tripled in one year, from 1993 to 1994. New "student traineeships" will allow students in years eleven and twelve "to combine their school-based studies with work experience and off the job training." The government expected to fund the purchase of off the job training "for up to 5000 students by 1995–96" (Keating 1994, p. 93). Policy makers in *Canada* are also promoting expansion of work-based learning for high school students, through co-operative education (de Broucker 1995) In *Sweden*, where upper-secondary vocational education was extended from two to three years beginning in 1992, students in these school-based programmes are now required to spend fifteen percent of their time during those three years in work settings.

Sweet notes that work-based learning in Australia is sometimes used to enhance academic studies. Although this practice is growing, it is still unusual, as work-based learning has more commonly been used as a complement to vocational studies. Gustafsson and Madsén (1995) bemoan the fact that the fifteen percent required work experience in Sweden is so far being attached only to vocational classes. Among countries that rely mainly on schools to provide vocational education, it is difficult to find examples of work-based learning tied to a curriculum that is explicitly designed to prepare students both for work and for further education. In the US the 1994 School-to-Work Opportunities Act provided federal money for states and localities to design and implement new school-to-work systems in which work-based learning is a required component. Section 103 of the Act stipulated that work-based learning must be co-ordinated with school-based learning and relevant to students' "career majors" (which integrate academic and vocational instruction and link secondary with post secondary education). For example, "career academies," which predated the 1994 Act, organise the high school academic curriculum around broad industry themes such as health, computers, or finance, and give students access to work in that industry during the summer and part time during the year (Stern, Raby, and Dayton 1992). Other examples in the United States are described by Pauly, Kopp, and Haimson (1995).

Most work-based learning for students takes place in business enterprises outside the school. Since the young people who participate are not regarded primarily as members of the enterprise but as students under the jurisdiction and supervision of the schools, the provision of work-based learning requires the formation of school business partnerships or at least informal collaborative arrangements. Somehow school authorities and their business counterparts must decide on the general purposes and content of work-based learning, create or select training materials, establish routines for placing and supervising students, evaluate students' performance, agree on disciplinary procedures if necessary, and settle economic issues such as legal liability, transportation, and students' wages. None of this is easy because most educators and employers are unaccustomed to working with each other. Even if companies are accustomed to employing students part-time as in the United States (and increasingly in Australia, Spain, and the United Kingdom), this is quite different from organising a work placement that serves a primarily educational purpose. For instance, work-based learning under the School-to-work Opportunities Act was required to provide "instruction in general workplace competencies, including ... employability and participative skills, and broad instruction, to the extent practicable, in all aspects of the industry." Bailey (1995) contains a discussion of these issues in the United States.

Even in Germany, despite the careful co-ordination of firm-based training regulations and school-based curriculum, Rauner (1995) and Koch (in OECD 1994, p. 123) both criticise the lack of direct, ongoing co-ordination between the schools and firms that compose the dual system. The teachers responsible for instructing apprentices in vocational schools tend not to meet regularly or often with the apprentices' work-site supervisors, nor do they make regular or frequent visits to the workplace to see what apprentices are doing. Consequently, they may not be able to refer in their classes to problems or situations that students are currently encountering at the work site.[20]

School-Based Enterprise

As an alternative to work-based learning in enterprises outside the school, educational institutions also engage students in productive work under their own auspices. In the United States, for example, school-based enterprises traditionally attached to vocational education in high schools have performed such tasks as building houses or operating retail businesses. The 1994 School-to-Work Opportunities Act has recognised "school-sponsored enterprise" as a legitimate form of work-based learning. Students in school-based enterprises have reported that these promote learning more than the jobs they find on their own (Stern et al., 1994). A 1992 survey for the National Assessment of Vocational Education found that nineteen percent of secondary schools in the United States were operating some kind of enterprise that involved students in producing goods or services for other people as part of their school activities (Stern 1992b). Most of these were associated with vocational programs. For example, students in construction trades may build a house; those preparing for food service occupations may run a restaurant; classes in automotive trades often repairs cars; and a child care class may provide day care for clients outside the school. Similar activities take place in two year colleges. These school-based enterprises are analogous to teaching hospitals run by medical schools or law review journals produced by law school students. The school enterprise provides practical experience that helps prepare students for subsequent work in a particular occupation or industry.[21]

Denmark has recently expanded its use of school-based enterprise. First, "production high schools" were created as a training and employment mechanism for young people who were not in school. These are not part of the regular education or apprenticeship system but serve unemployed young people who have completed compulsory schooling without obtaining a vocational qualification. They combine instruction in academic and vocational subjects with production of substantial products, for example furniture or clothing, for sale to the public (but avoiding unfair competition with commercial producers). As of 1992 there were 120 production high schools enrolling approximately 9,000 students (Danish Ministry of Education 1994, p. 132). This represented roughly 5 to 10 percent of the 15-29 age group.

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[20] Jeff King points out, nevertheless, that coordination between educators and employers "is known to be very deep and very comprehensive, from the national level, the state level, the unions, the Chambers which coordinate curricula and exams between schools and firms, the national, state, and regional employers associations, the national association of firms for qualification standards (Q-Verband), and a vast range of other formal and informal contacts and structures for coordination."

[21] Another type of school-sponsored enterprise is the student-owned business that is incubated in an entrepreneurship class. For example, REAL (Rural Entrepreneurship through Action Learning) is one organization in the United States that provides an entrepreneurship curriculum for helping students, primarily in rural areas, develop such enterprises which may then "graduate with the student" and become part of the local economic base. In contrast, the school-based enterprises described in the text are owned by the school and may continue to enroll students in succeeding years.

When apprenticeship placements became scarce in the 1980s, Danish policy makers built on the precedent of the production high schools to create a new option within the regular apprenticeship system. Commercial and technical colleges were authorised to use school sponsored enterprises to provide the work experience that would ordinarily be offered by non school enterprises (Danish Ministry of Education 1994, p. 101; Østerlund 1995). Printing, retailing, and construction are examples of the activities carried out by school enterprises. There are some indications that employers prefer to have trainees work in school-based enterprises rather than in the firm during the early part of their training, when they are less profitable for firms to hire as apprentices.

School enterprise can also be used to provide work-based learning for students who are not yet specialising in a particular occupation or industry. The Junior Achievement (JA) programme in the US is one of the oldest examples. Started in 1919, JA has involved millions of students in mini-enterprises, usually on an extra-curricular basis but sometimes for course credit. JA is sponsored by the Chamber of Commerce which recruits adult volunteers to serve as advisers, and furnishes instructional materials. During one semester or year, students start up a company by raising equity capital (typically a few hundred dollars from relatives, friends, or their own savings), electing officers, and setting up accounts. They decide on a product—often a small gift item—then buy materials, produce the goods, and sell them. At the end any profits are distributed among the stockholders.

The *United Kingdom* took mini-enterprises one step further. After an organisation called Young Enterprise, modelled on JA, had taken up the idea as an extra-curricular activity for students, the government in the 1980s promoted mini-enterprises as part of the school curriculum, providing start-up funds, teacher training, and curriculum materials. By the late 1980s and early 1990s, approximately 40 percent of government-supported secondary schools were reporting that they sponsored mini-enterprises. These were seen as effective means for students to learn about work, for work, and through work (Jamieson, Miller, and Watts 1988), though not to train for specific industries or occupations.

The *German* dual system, which epitomises employer-based training, actually contains important elements of school-based enterprise, though they are seldom called that. Large German companies operate separate training facilities where apprentices spend much of their time, away from the regular productive operations of shops, offices, and laboratories. According to Koch, "Especially in large companies, training generally takes place outside the work processes and is largely carried out in training workshops, offices for practice, and classrooms." (OECD 1994 p. 122) Some small employers have also established inter-firm training centres for their apprentices at a different location than the firms' actual places of business. These training facilities and inter-firm centres may not be called schools, but in fact they are, although they are owned and controlled by employers or employer organisations. One might call them enterprise-based schools where the young trainees take classes and receive formal instruction. But the apprentices in large firms' training workshops also engage in productive activities that benefit the company—for example, producing parts for use in the main factory. The most appropriate term to describe such productive activity in these settings would be school-based enterprise within enterprise-based schools!

A particularly good example of school enterprise for the learning based economy is a German-sponsored organisation located in *Singapore* called the German-Singapore Institute (GSI). Founded in 1981 as a joint venture between the Economic Development Board of Singapore and the German Agency for Technical Co-operation, GSI calls itself a "teaching factory." It carries out applied development projects for local manufacturers, while preparing technicians and middle managers in the fields of advanced manufacturing technology, factory automation and robotics, plastics manufacturing technology, and (since 1992) manufacturing software. In 1994 GSI enrolled about 1,100 students and planned to grow to 2,000 students in the next six years. Students spend most of their two or three years in laboratories equipped with state-of-the-art production equipment, much of it donated by German manufacturers. In 1991 the German Machinery and Plant Manufacturers' Association gave GSI the German Mechanical Engineering Award with a citation that commended GSI's "project-oriented approach to training within a comprehensive and practice-oriented environment." The GSI model has been emulated in Malaysia, Brazil, and elsewhere.

The capstone experience for students at GSI is the applied project in the last semester, which engages them in "production for learning." An Industrial Project Group (IPG) contracts with local companies and takes responsibility for meeting clients' cost, performance, and delivery requirements. The full-time engineers and designers in the IPG assign students to work on these undertakings, usually in groups of four to six. Projects may involve design and construction of automated manufacturing units, for example, to assemble or package electrical components. Students take responsibility for scheduling and organisation, purchase of supplies, and cost calculation. Teamwork, problem-solving, and creativity are emphasised.

GSI is organised in some ways more like a business than a school. Unlike most schools in Singapore, GSI teachers are not civil servants but are hired by the Employment Development Board and paid at the industry scale. Faculty and students work 44 hours a week. Instead of long holidays typical of an academic calendar, they receive only short vacations as in industry. The departments at GSI also have names that represent productive functions like tool and die making, design, and data processing, rather than academic disciplines.

In the emerging economy where production intertwines with on-line learning, the dichotomy that has divided education and schooling from work and productive enterprise has begun to break down. Integration of academic and vocational curriculum, active pedagogy that treats students as "knowledge workers," and work-based learning in enterprises inside or outside the school all blur the conventional boundary between education and work. These policy initiatives are logical responses to the recognition that productive knowledge is increasingly evanescent. Although education always will include some rote memorisation and abstract exercises, and work will always include some following of orders from supervisors or clients, these no longer suffice. More than in the past, education for work must prepare a person to ask good questions and use good judgement in a practical context.

VI. Governance

Effective school-to-work programmes require partnership between educators and employers. As noted throughout this paper, the apparent success of school-to-work systems in the German-speaking countries seems to be associated with the exceptional degree of responsibility that employers have taken for the education and training of young people, which necessitates close collaboration with educational authorities in planning, implementing, and monitoring apprenticeships (Hamilton 1990; Soskice 1994). This collaboration in education and training is part of a larger set of joint decision-making relationships between governments and representatives of business and labour, often called the "social partners." This joint decision-making influences wage determination, health and retirement benefits, unemployment programs, and other social issues.

In other nations on the European continent, employers traditionally have not participated in the education and training of young people to the same degree as in the German-speaking countries, but the tradition of centralised decision-making between government and the social partners does exist. As described in previous sections, many of these countries have adopted policies to increase employer involvement in education and training. The existence of centralised decision-making with the social partners facilitates the adoption and implementation of these policies. The examples of Denmark and the Netherlands will be described in this section.

The English-speaking countries generally lack both the tradition of major employer participation in the education and training of young people and the tradition of strong centralised decision-making between the government and the social partners. When governments in these countries seek to increase employer involvement in youth education and training, the absence of a forum for joint decision-making with the social partners makes the adoption and implementation of such policies relatively difficult. Recent experiences in the United Kingdom and Australia will be summarised in this section.

In *Denmark*, vocational education reform carried out between 1989 and 1991[22] has created a governance structure based upon strong central and local co-operation, both formal and informal, between education and labour market constituencies (Østerlund 1995). The social partners have such a "strong comprehensive influence...(that) no important decisions are made without their participation." (OECD 1994: 7, 18). The social partners are represented on committees that function on local and national levels to develop and maintain vocational schooling and in-company training courses, and establish recognised certification in vocational training and education programs.

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[22] The Vocational Education and Training Act and Law 210 for vocational schools and Law 211 for vocational education and training were passed between 1989 and 1991 to replace the 1956 Apprenticeship Act and the 1977 EFG Act on Basic Vocational education (OECD, 1994).

The Federal Ministry of Education sets the overall, general objectives and rules for the content and financing of vocational courses based upon recommendations from its social partner advisory board, the Vocational and Training Council, comprised of representatives appointed by the Danish Confederation of Trade Unions and the Employers' Confederation. It advises the Ministry on issues such as the objectives and structures of courses, approval of new courses, programme analysis, research and development, the general qualification of teachers and student entry requirements. The Ministry's orders are then carried out by its executive body, the Department of Vocational Education and Training.

National Trade Committees, formed by industry associations and labour unions, are responsible for formulating the technical objectives and qualification descriptions for vocational education; assuring that curriculum, standards, and assessment meet current labour market needs; and setting up the rules for the practical in-company component of training (Østerlund, 1995; Jenkins, 1995). Although they are clearly the vocational arm of the training process, trade committees have "acquired a great deal of influence over the school portion of vocational education and training" and now provide input into the duration, structure, contents and targets of courses in basic subjects, trainee periods, placement, and testing (OECD: Denmark 1994, p. 9). Unlike many countries where industry groups take on a policy advisory mode, trade committees in Denmark "play a central role in governance of technical colleges where the in-school portion of vocational education takes place" by getting involved in the specifics of curriculum development and reducing the proliferation and overspecialisation once found in technical education programmes (Jenkins 1995:2).

Local Education and Training Committees, made up of local employers, employees and educators, are appointed by the National Trade Committees to advise schools, promote co-operation between education and labour market participants, and assure that training meets current local standards. With Danish reform efforts emphasising a decentralised vocational system, Local School Governing Boards, using input from local education and training committees, have almost exclusive freedom for planning, curriculum, and financial management of vocational programs. All detailed educational planning and execution, once a federal responsibility of the Ministry of Education, has been assigned to the local level. Consistent with current reform policy, membership on local school governing boards is divided equally among Danish social partners.

The existence of these deliberative and joint decision-making bodies at various levels has helped to create consensus about the direction of education and training, and to carry it out. The result, as described in previous sections, is that the Danish system has evolved toward a flexible web of interconnected programs, allowing students to move back and forth between academic and vocational pathways.

Vocational education reform in the *Netherlands* has also relied extensively on governance from "national tripartite bodies" comprised of representatives from industry and vocational education. These National Bodies for Vocational Education develop occupational profiles and translate these profiles into elements of competence in secondary vocational education. They constitute an important link between industry, the government and educational institutions having primary responsibility for the realisation of a single qualification system for both the MBO (upper secondary education) and the apprenticeship system. (Van den Dool and Weijs 1994; Streumer 1994). Reforms under this structure have been successful in integrating secondary vocational education into four main sectors (technical, administrative, service and agricultural), merging educational institutions into larger entities, and decentralising vocational administration to make education more effective and efficient in meeting industry needs (OECD: Netherlands 1992).

The initiatives taking place in the Netherlands include closer linkages between vocational educators and industry, particularly between local companies who offer student internships and serve on or administer advisory boards and vocational schools. Not only are senior secondary and higher vocational education teachers offered internships to upgrade their skills and facilitate the implementation of new industry techniques in the school, but company employees are encouraged to serve as visiting or practical teachers to offer current vocational knowledge and teach new skills and aptitudes applicable to vocational practice (Streumer 1994). There is also evidence of strong instructional co-operation and communication emerging between vocational schools and companies in efforts to adapt curriculum to current career pathways in the local labour markets.

Especially notable in the Netherlands is the involvement of educators from both general and vocational education at secondary and higher levels in developing a new, more unified, vocational qualification system (Streumer 1994). Although national focus has remained on the development of intermediate work force skills, there is an increasing emphasis on work force preparation in all levels in the educational community—even the college level. The government has supported institutional integration at higher vocational education levels by fusing "colleges providing only full-time courses with those delivering the school-based element of apprenticeship courses (in the hope that) bringing these different learning routes under the same roof could give an impetus to innovation on both sides." (Van den Dool and Weijs 1994, p. 4) Not only has there been growth in the number of vocational courses offered throughout the entire system but a movement toward more occupational practice in the vocational courses themselves. Many lower level general education courses have added a career exploration component (van den Dool and Weijs, 1994). Likewise, many universities have strengthened the vocational elements within their initial courses by adding internships and practical assignments—up to 10 percent of the first phase of schooling (Streumer 1994).

Although both academic and vocational educators appear to be working toward similar goals by including vocational components in both of their curriculums, there is little solid evidence to indicate that they are doing this together in any sort of unified forum. While general and vocational educators both appear to be working more closely with industry, they are not necessarily co-operating with each other. This is similar to the situation in Denmark where there is direct collaboration between vocational educators and industry but the co-operation between academic and vocational educators is more indirect.

The *United Kingdom* has attempted in various ways to involve employers and educators in joint governance of education and training. Since the early 1980s, several industry based efforts have dominated the development of occupational standards in England. In particular, the government delegated the task of identifying specific standards of competence required for particular occupations and jobs to the Industry Lead Bodies. These bodies were mostly made up of employers and sponsored by the Department of Employment. A 1981 white paper, "A New Training Initiative: A Programme for Action," issued by the Government highlighted the key role that education must take in training. The paper promoted academic and occupational integration by stating that "...the basic concept of providing a foundation of skills and knowledge by a combination of off the job training, classroom teaching, and work experience is as relevant as ever" (OECD: United Kingdom 1994).

The National Council for Vocational Qualification (NCVQ) was established in 1986 to rectify the lack of consistency among existing standards and confusion among employers regarding the value of different levels and qualifications developed by various industry awarding bodies. This Council was given responsibility for setting up a unified framework for vocational qualifications as well as overseeing and co-ordinating the standards set by industry associations and awarding bodies (Payne, 1994). Their framework formed the basis for National Vocational Qualifications (NVQs) which are primarily (but not exclusively) intended to assess the work-based performance of employees of all ages.

The NVQs are specifically designed to be independent of any educational system or program. This has the advantage of allowing certification for workers who learned their skills informally or in a programme that is not attached to a particular certification scheme. The approach is designed to put certification and training squarely in the hands of employers (OECD: United Kingdom 1994). While educators have begun to develop curricula around the NVQs they have so far played a relatively minor role. One of the emerging problems with the NVQ system though is that the private sector has had less training capacity than had been expected. Thus, while there was substantial employer involvement in the process of defining the NVQs as skill standards, educators are playing a much greater role in the delivery of training (Vickers 1995b).

In contrast to the NVQs, the new vocational secondary degree—the General National Vocational Qualification (GNVQ)—is school-based. In this case, there appears to be a growing collaboration between general (or academic) and vocational teachers, although up to this point, employers take a decidedly secondary role in this system (OECD: United Kingdom 1994). Thus the NVQ system is primarily employer-based with a minimal role for educators, while the GNVQ system has made progress on integrating academic and vocational education with much less involvement from employers.

The implementation of the Scottish Vocational Qualification (SVQ) system appears to have achieved a more balanced partnership between the education system and the private sector than its English counterpart. Vocational education in Scotland is regulated by the Scottish Vocational Education Council (SCOTVEC), an independent entity created in 1985. SCOTVEC runs vocational and technical education and training and works with both the employers and Further Education colleges. The Council was developed by consolidating the Scottish Business Education Council (SCOTBEC) and the Scottish Technical Education

Council (SCOTEC) and works as a private company under the general oversight of the Scottish Secretary of State to develop and promote vocational education and training as an national policy. SCOTVEC has the authority to develop and accredit courses and modules, award certificates (including SVQs), and approve alternative training providers.

When the SVQ system was established in 1986, it was built on the previously existing Scottish Action Plan which was developed in the early 1980s. The Plan developed a set of modules leading to a National Certificate (NC). Modules required approval by SCOTVEC and any organisation could teach them as long as it achieved SCOTVEC approval. In practice employers and educators worked together to define skill standards, and the Further Education Colleges developed curricula to teach the NC modules. Thus educators have been intensively involved with the SVQ system since its inception. In a system where educational institutions already had a stronger role, SVQ reforms created a more even balance of influence by strengthening the role of employers (Vickers 1995b).

Also in contrast to the situation in England, the General Scottish Vocational Qualification is closely related to the SVQs. In England, there is relatively less interaction between the NVQ and GNVQ systems. Things are different in Scotland because both SVQ and GSVQ systems emerged from the National Certificate system developed by the Scottish Action Plan (OECD: Scotland, 1994). Thus the developments in Scotland have brought together employers with both academic and vocational educators.

Australia's vocational reform has been successful in developing a strong national framework, based on national industry competence standards, for involving industry representatives in the governance of vocational education (OECD: Australia 1994). In some fields, especially metalworking, automotive, and tourism and hospitality, employer input to the development of competency-based standards has been strong, as has support for implementation. However, the level of support is not consistent across industries. As in Denmark, there is overt co-operation between vocational educators and employers, but less obvious co-operation between vocational and academic educators.

The Federal Government has assumed an important role in promoting national consistency across the country's training systems as well as redefining traditional roles and relationships (OECD: Australia, 1994). The national Australian Standards Framework (ASF) is the primary vehicle for industry participation centring around competency standards established by each industry (Noonan 1994). By the end of 1994 standards endorsed by the National Training Board covered more than half of the Australian work force. Under the National Framework for Recognition of Training (NFROT), State and Territories register training providers and validate industry-developed assessment and certification mechanisms. Training providers may be TAFE colleges, accredited firms, or private-sector training vendors. Within the NFROT framework, States and Territories take responsibility for the recognition of accredited courses, for funding the provision of training programs, and for awarding credentials for vocational training (OECD: Australia, 1993).

New pay structures favouring broadly based, multi-skilled workers led, in tandem with the industry standards being developed, to joint education and labour participation in the Ministry for Vocational Education, Employment, and

Training (MOVEET). This new Ministerial Council involves "ranges of Commonwealth and State officials and key industry people who were committed to a common agenda involving both a more industry driven and responsive system and the need for these reforms to be undertaken on a nationally consistent basis" (Noonan, 1994) . In past governance structures, Federal/State Ministerial Council members, in charge of industrial relations and labour issues, worked separately from Ministers who were responsible for the more educational aspects of the Technical and Further Education (TAFE) system. In contrast, the new merged system allows "industrial relations, training and industry issues to be considered in an integrated way" and led to a consortium of individuals "committed to a common agenda involving both a more industry driven and responsive system and the need for these reforms to be undertaken on a nationally consistent basis." (Noonan 1994, 13)

Securing the participation of private sector employers in Australia has not been easy, although some firms and sectors such as Qantas, the automobile industry, and the hospitality and tourism industries have been very much involved with training. Thus as Goozee (1995, p. 119) points out, "At present, the capacity of employers and their willingness to participate in the system is largely untested and uneven where it does exist." Given the convoluted structure of national and State employer associations in Australia,[23] the country lacks a unified voice for employers. This has created marked differences and fragmentation among employers regarding current vocational reform issues such as "the future of the apprenticeship system, the importance of enterprise-based training models for young people, the role of national standards and the conditions under which structured training should be extended.." (Sweet 1993, p. 3).

Although vocational educators are involved in vocational reform at the national level, educators at the local level are not always committed to the Australian Vocational Education and Training (VET) reform agenda which "commands wide support among Commonwealth, State and Territory Governments, employers, and unions" (OECD: Australia 1992, p. 4). Reported observations of union and employer representatives indicate a lack of educational integration leading to "total bewilderment that is the common reaction of classroom teachers to the reform process...(and) complaints from teachers that the agenda is a top down one in which they have no involvement" (Sweet 1993, p. 1). On the other hand, some of this resentment may be accounted for by the rapid pace of change that Australian educational system has experienced in the last few years.

In sum, Australia has achieved a significant reform of its vocational education governance structure. National level government officials, educators, union representatives, and employers have devised more co-operative procedures. Still, more work will be necessary to gain the full participation of the more academically oriented teachers and local-level employers and educators.

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[23] Australia has three or four primary national employer bodies "depending on how you define them" and about eighty secondary bodies with variable overlap between the two. Several hundred State employer associations exist. (Sweet, 1993)

All of these countries have worked to forge partnerships between employers and academic and vocational educators. Securing the full participation and co-operation of academic educators in these reforms has received much less attention than the participation of employers. In many cases, the developments that we have been discussing are seen as reforms of the vocational education system. The Netherlands is an interesting case in which attempts have been made to strengthen this aspect of the governance structure. One result is that the reforms have started to influence the content of the academic as well as the vocational streams.

VII. Conclusion

The emergence of a more learning-intensive economy has begun to change the relationship between education and work. As employers try to promote on-line learning and people move more frequently from one job to another, continual learning at work becomes increasingly important.

Four main elements characterise an education system that is likely to prepare students effectively for this new environment. Three of these elements—skill standards, workplace learning, and strong links between employers and schools—are evident in countries where school-to-work systems have worked well in the past. Accordingly, countries with less successful systems have been introducing reforms that incorporate these features.

But these elements are no longer sufficient. In addition, most countries have also found it necessary to create a closer connection between academic and vocational education, because neither traditional form of education by itself is likely to meet the requirements of learning-intensive work. To prepare for continuous change, school-to-work systems are now called upon to equip students both with the abstract theory and analytical skill that the academic curriculum has traditionally tried to teach and the knack for practical application that has been a hallmark of vocational education. Employer involvement, skill standards, and work-based education are reflecting this new policy direction to varying degrees in different countries.

In some countries the merging of academic and vocational streams has been occurring through upgrading the academic content of studies within vocational institutions or programs. For example, in Germany the dual system of occupational education brings the average apprentice to a relatively high level of theoretical understanding, and training standards are constantly being revised and upgraded. In France and Sweden, vocational education takes place mainly in schools, unlike Germany where employers themselves do most of the training. But in France and Sweden, as in Germany, the integration of academic and occupational education has occurred mainly by adding more academic content to vocational programs.

By contrast, Britain and Japan have recently created new curricular options that are not confined to vocational institutions. These new curricula use occupational or industry related themes as a focus for organising the study of academic subjects. In Britain, and also in Australia, the new integrated programmes are supported by new performance standards, work-based learning, and greater participation of employers.

In all these countries, one explicit purpose of linking vocational with academic education is to make it easier for vocational graduates to continue their education at a university or other post secondary institution. Students who enter the work force immediately after leaving one of these integrated programmes still retain the option of continuing their education later. Conversely, those who proceed directly to higher education have the option to change their minds and enter the work force. The integrated or upgraded vocational programme thus prepares individuals for both work and continued learning, allowing easier movement from one to the other.

The findings of this report are encouraging for the United States, where local communities, states, and the federal government have been spurred by continuing criticism to undertake major changes in the institutions that usher young people from education to employment. Although the evidence about youth unemployment in this report suggests that the United States does not, in fact, have the least effective school-to-work system in the industrialised world, it has not been the most effective either. Most American 20 year-olds probably have not achieved either the mastery of academic subject matter or the level of occupational proficiency attained by their counterparts in Germany, for example. But in the United States, where control of education and training is more decentralised than in most other countries, many localities have launched initiatives that are preparing young people for college and careers at the same time (*Business Week*, 1996). There is evidence that these initiatives are raising achievement levels (Stern et al. 1995). The main cause for optimism in the United States is that the recent reforms taking shape in some American schools and communities—combining an academic and occupational curriculum with work-based learning and high standards for all students—appear likely to provide the best preparation for young people entering an economy where learning and work are increasingly intertwined. The fact that most other industrialised countries either have been moving in this direction for some time or are now beginning to do so corroborates the logic of these efforts.

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Figure 1

Unemployment Rates for Youth and Adults - 1979

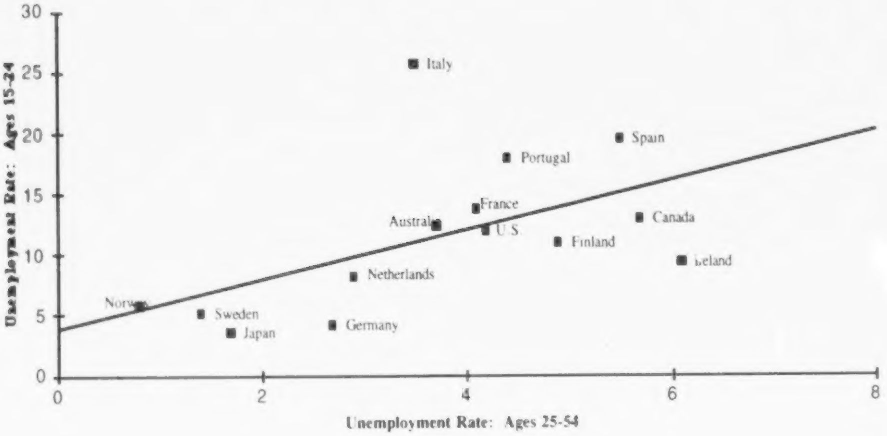

Figure 2

Unemployment Rates for Youth and Adults - 1983

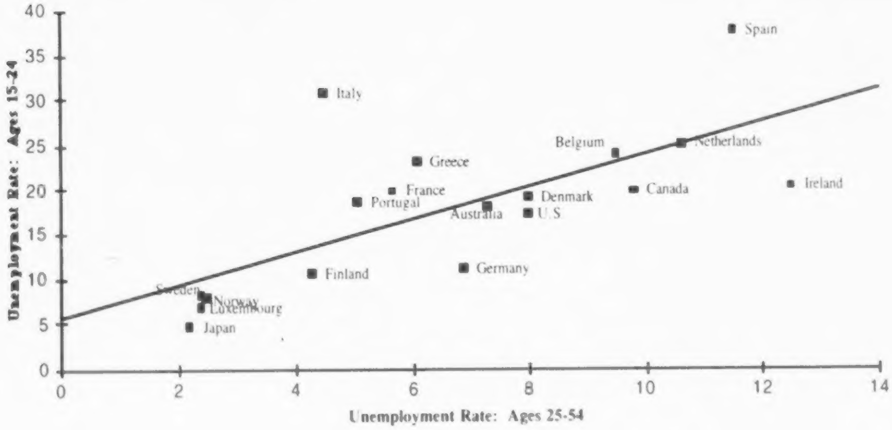

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Figure 3

Unemployment Rates for Youth and Adults - 1990

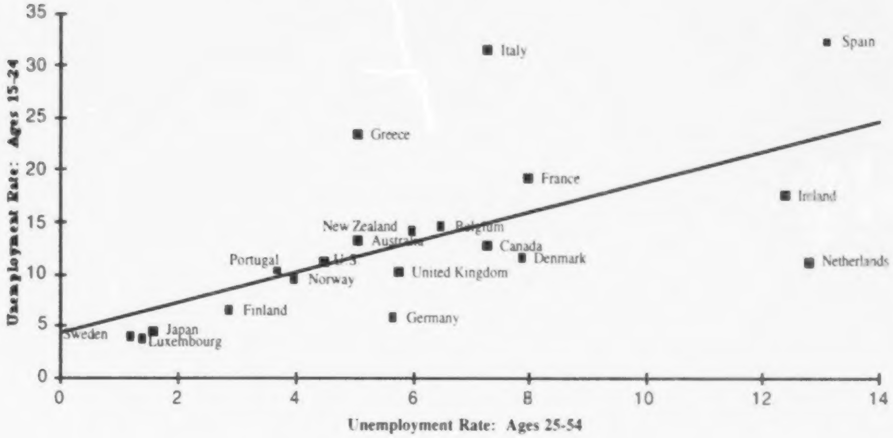
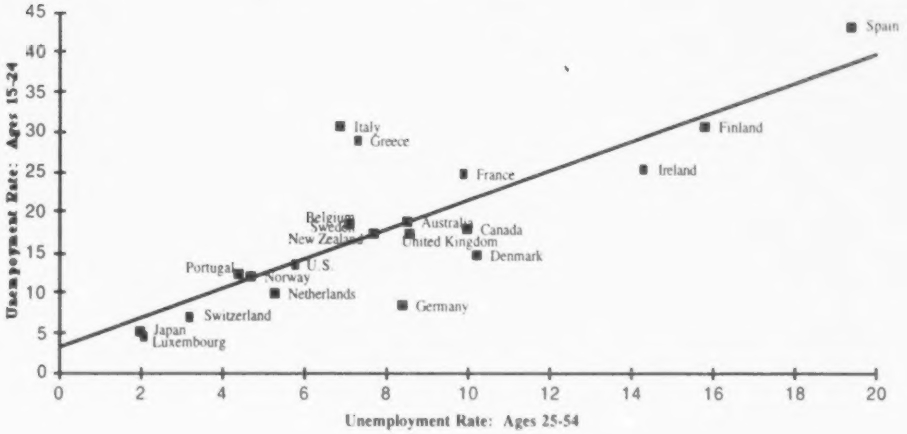


Figure 4

Unemployment Rates for Youth and Adults - 1993



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Competency-Based Education—
Neither a Panacea nor a Pariah

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Introduction

It is common for Australian university academics to be critical of competency-based education systems. The values that underpin a competency-based approach and those on which traditional university education have been based are often seen to be at odds. A focus on the development of prescribed workplace skills is seen by many academics to be inconsistent with a focus on the general development of the mind. Not surprisingly, we found in an Australian study a few years ago (Bowden and Masters 1993, pp 100–102) that more than half the academics expressed negative views about a competency-based approach to university education on the grounds that such an approach is too narrow and conformist. Yet nearly 80% of those same academics indicated that they had had no experience of a competency-based approach and nearly 60% acknowledged that they had little or no knowledge of what a competency-based approach to education is about.

As this paper proceeds, those who have not paid much attention to the competency debate over recent decades will come to realise what those who have been following the debate already know, viz that the Australian finding is not unusual. Much of the debate has been based on ignorance. This does not mean that the academics' views cited above must be wrong but it does mean that they are no more telling than the similar attacks on university agendas by assertion rather than by argument, by some in the competency movement. Something more than mere assertion is needed for the debate to lead to constructive outcomes.

Anyone concerned to address these issues needs to analyse what the competency movement is about, consider what the mission of tertiary education should be in the late 20th century and attempt to discover whether there are some common purposes to be served and something to be gained by abandoning the siege mentality of many on both sides of the debate. Such a process should have two things in mind.

The first is that the quality of student learning should be at the centre of any argument

The second is that there is a need to acknowledge that both the competency movement and the nature of tertiary education have been changing over time.

This paper attempts to make a small contribution to that process. The perspectives from which competency-based education is analysed in this paper include a brief political and historical account, an analysis of the nature of a competency-based approach, consideration of the relation between competencies and competence and some attention to its basis in educational theory.

From my perspective, competency-based education is neither a unique, earth-shattering device for completely overhauling approaches to teaching and learning in post-secondary institutions, nor a self-evident blight on the educational landscape that should be eliminated, although there are many who hold one or other of those two extreme views. Historically, the competency movement has embraced some narrow, educationally suspect practices which have attracted due criticism. On the other hand, it has certain elements which are shared with other educational reform agendas and in that sense it is valuable but not unique.

Its presence in recent decades has been catalytic and has focused attention on some important educational reform issues and has been influential on educational change outside those areas that have actually adopted a competency-based approach. This applies particularly to the relation between the educational institutions and industry and also to the nature of the professions. In addition, within the competency movement, the idea of what a competency-based approach should be about has been evolving and many current practices are in stark contrast to earlier, less acceptable versions of competency-based education. Of course, in many other cases, practices have not changed much at all.

The competency debate has never been a subdued one. In most countries in which competency-based education has been on the agenda, there has been a time when the majority of commentators has appeared to have adopted either one or the other of the extreme positions mentioned earlier. My comments derive from first-hand experience in Australia during the 1990s, when I appeared on various platforms with a number of university vice-chancellors, trades union leaders, heads of government departments, members of industry training boards and leaders of professional associations. Those conferences and meetings during the early 1990s in Australia were vitriolic and political, with first one and then the other participant painting such an extreme picture of their opponent's perspective on competency-based education that all arguments were completely polarised.

It appeared that any individual had to be depicted either as opposing any preparation for work whatsoever in university degree programmes or, on the other hand, as being totally opposed to any learning not related to prescribed work performance. Nothing in between these opposite positions was recognised in such debates. For several years, educational newspapers and some parts of the Australian popular press avidly documented the polemics that emerged from those encounters. The polarised debates are reminiscent of the "behavioural objectives" debates some decades ago and have been commented on by Harris et al (1995) in a publication with the graphic title "Competency-based Education and Training: Between a Rock and a Whirlpool."

There have been unfortunate consequences. The nature of the debate has meant that political criteria have had a greater effect on decision-making within educational systems than they otherwise would if the debate had been more focused on learning. As a consequence some undesirable competency-based practices have been introduced, in Australian further education for instance, in forms that are not as educationally sound as they could or should be, to the dismay not only of commentators like myself but also of teachers in the system (see Kinsman, 1992).

Another feature of the debate has been the suggestion by some in universities that a competency-based approach is appropriate for training institutions but not for university education. I find this to be an unacceptable proposition and throughout this paper I do not make a distinction between education and training. I have difficulty in seeing training as being a different kind of activity from education when applied to the learning processes that people engage in to acquire qualifications or to develop their competence in the workplace. To the extent that training means learning to do something without understanding how or why, then it is to me merely an inferior form of education. This is unfair to students.

Worse still is to consign a particular group of students, or kind of work roles, to a learning programme which makes such an assumption. I can think of no occupation where understanding is a hindrance. The kinds of responsibilities that a plumber, a doctor, a mechanic, an engineer, a nurse, a carpenter, a teacher or an electrician each has, require judgement based on understanding of the context in which they are working and the relevance of their own knowledge and skills. To suggest that some of these obviously need to be trained while the others need to be educated seems to be without basis and not to take seriously the real nature of work. Unfortunately, the further education sector in Australia is distinguished from the higher education sector by the title VET (vocational education and training) which perpetuates this unfortunate view.

My interest in competency-based approaches has been as a researcher and as a manager of educational change in RMIT, a university of technology which provides both higher and further education programmes in integrated faculty structures. RMIT's intention is to develop a seamless system of education which embraces both sectors. I am interested in the same issues that drive the competency-based agenda but I am more interested in the conceptual and pedagogical aspects of the debate and the relation between educational experience and professional practice than I am in the political or economic aspects, let alone the economic rationalist agenda.

My involvement relates to a project team I led and a monograph we wrote for the Australian Federal Government (Bowden and Masters 1993), on the implications of the competency movement for higher education, with the Australian further education (VET) sector having already adopted a competency-based approach. The conclusions of the study were moderate although the term moderate should not be taken as implying any uncertainty or lack of conviction. To the contrary, our conclusions might be described as aggressively moderate as we saw the competency movement as neither a panacea nor a pariah. There are useful aspects of competency-based approaches that should cause all tertiary teachers at least to pause and question their own practices. However, there also are forms of competency-based education which do not provide adequate learning experiences for students and which should not be adopted. Hence our conclusion was that neither of the polarised perspectives described earlier was tenable and that it was inappropriate either to reject outright all ideas associated with the competency movement or to embrace any particular competency-based approach without question. (Some conclusions of our study are listed later in this paper.) It is perhaps a reflection of the polarised debate already alluded to that our findings were criticised to an equal extent by university vice-chancellors and by members of the competency movement.

History and Principles Of Competency-based Systems

The concept of a competency-based education system is both an old and an evolving idea, details of which are still being worked out, especially in relation to higher education institutions and the professions. The notion of competency-based education programmes was first introduced in the USA, beginning in teacher education in the late 1960s, and evolved through applications to other professional education programmes in the USA in the 1970s, vocational training programmes in the UK and Germany among others in the 1980s and vocational training and professional skills recognition in Australia in the 1990s.

Such approaches have been promoted as key elements in the Australian Federal Government's agenda for training reform and improved skills recognition and, in promoting it in that way, the Australian Government have followed the lead of their counterparts in the UK. Competency-based approaches have been seen to have the potential not only to influence the ways in which employment-related skills are assessed and recognised, but also to influence the structure and delivery of formal education and training programmes and to provide enhanced opportunities for articulation between sectors and for credit transfer across institutions.

In seeking the origins of the competency-based movement, some writers point to parallels with the scientific management theories of Frederick W. Taylor in the early twentieth century. While some elements of competency-based education have clear parallels with Taylorist approaches and may indeed have been influenced by Taylor's work, competency-based education is most directly descended from the behavioural objectives movement of the 1950s in the United States. Its origins are found in the thinking of educators such as Benjamin Bloom.

The behavioural objectives movement sought to focus attention on the intended outcomes of learning programmes and, in particular, to encourage teachers to express their instructional objectives as changes in observable student behaviours. Proponents of the movement advocated the specification of objectives as 'directly observable behaviours which can be reliably recorded as either present or absent' (Bloom et al. 1971, p 28). An important feature of the movement was the desire for reliability of observation and judgement. Writers of behavioural objectives were encouraged to state outcomes 'in terms which are operational, involving reliable observation, and allowing no leeway in interpretation'. In an attempt to achieve this degree of reliability, statements of educational objectives begin with verbs describing student behaviour such as 'states', 'lists,' 'names,' 'selects,' 'recognises,' matches,' and 'calculates' (Bloom, et al. 1971, p 34). It is this narrowness that has led to much of the criticism of such approaches, then and now.

The behavioural objectives movement of the late 1950s and 1960s gave rise in the 1970s to four related developments: mastery learning (Bloom 1974); criterion-referenced testing (Popham 1978); minimum competency testing (Jaeger and Tittle 1980); and competency-based education (Burke et al. 1975)

Although the imperatives for the introduction of competency-based education have been different in different countries at different times, and the ways in which this concept has been operationalised have changed over time, the basic principles and intentions of competency-based education have remained essentially unchanged since the 1960s. They are:

- a focus on outcomes
- greater workplace relevance
- outcomes as observable competencies
- assessments as judgements of competence
- improved skills recognition
- improved articulation and credit transfer

There are two themes through these. One derives from economic and social theories and is the basis for the political debate which has threatened to overwhelm the pedagogical questions. The second concerns the relation between the world of learning and the world of work and the mechanisms by which experience of one is a preparation for participation in the other.

This paper focuses on the second rather than the first of these two themes. A more complete analysis of the history of the competency movement and the principles of competency-based approaches may be found in Bowden and Masters (1993) from which this account draws and which describes developments in Australia in the 1990s. Houston (1985) describes the early movement in the USA in the 1970s while Jessup (1991) and Tuxworth (1989) deal with UK developments in the 1980s.

A focus on outcomes

A first characteristic of competency-based education is its emphasis on the specification and assessment of outcomes (referred to as competencies). This focus on outcomes is often contrasted with more traditional concerns of educational programmes with inputs such as methods of student/trainee selection, lengths of courses and training programmes, class sizes, teacher-pupil ratios and so on (Spady 1977; Johnston 1992).

Of course, competency-based education is not unique in its intention to focus more sharply on educational outcomes. This intention is central to many current initiatives in education in many countries, including the development of educational performance indicators; the setting of national educational goals; the introduction of statements and profiles for key areas of the curriculum; and the development of programmes to assess and report levels of student achievement and to monitor educational standards over time. These initiatives share an intention to clarify and to communicate educational outcomes and to establish frameworks for setting goals and monitoring progress towards the achievement of those outcomes. This kind of framework applies both to the system and the individual level.

What distinguishes competency-based education from this broader orientation towards the clearer specification and monitoring of outcomes is its concern with outcomes relevant to employment.

Greater workplace relevance

Running through the literature on competency-based education is an ongoing concern over the workplace relevance of much of the content of formal educational programmes. There is a commonly expressed belief that institution-based courses too often emphasise theoretical or 'book' knowledge at the expense of the ability to apply knowledge to perform practical tasks and to fulfil workplace roles (Tuxworth 1989; Jessup 1989, p 66). Recent initiatives in Australia to promote competency-based education have similarly been based on concerns over the workplace relevance of many formal educational qualifications:

> Dissatisfaction with the workplace relevance of many credentials derived in the traditional model of curriculum development based on the inputs of 'knowledge,' 'understanding' and 'skill attainment' has led to an emphasis on working from the outcome—increasingly referred to as a competence. A competence is the ability of the learner to put skills and knowledge into action. (Humphrey 1992, p 61)

Under competency-based approaches, the redesign of curricula to make them more relevant to workplace requirements normally begins with an analysis and identification of workplace 'competencies' which are then organised into a set of 'competency standards' for an occupation. To ensure that standards are firmly based on the needs of employment and not merely on doubtful assumptions about workplace needs, competency-based educational reforms look to industry to take the lead in developing appropriate standards and to involve persons in the workplace as widely as possible in determining and endorsing competency standards.

Outcomes as observable 'competencies'

A third intention of competency-based approaches is to express outcomes as explicit, observable workplace performances. The intention is to express outcomes in the form of clear and precise 'competencies', so that (a) the needs of employment can be better communicated; (b) the goals of educational programmes can be re-defined and communicated with greater precision; and (c) straightforward judgements can be made about the extent to which any particular competency has been attained:

> Rather than designing curricula to meet assumed needs, representative occupational bodies identify 'occupational standards' which are clear and precise statements which describe what effective performance means in distinct occupational areas. The standards are then used to develop 'new' vocational qualifications and the assessment which underpins them; plus learning programmes which deliver the achievements identified in the standards. (Mansfield, 1989, 26)

Explicitness and precision are recurring themes in discussions of competency-based outcomes. If outcomes can be expressed in precise, observable terms, it is argued, these can then be used to set clear goals for educational programmes. For Gilbert Jessup, a leading advocate of competency-based education in the UK, precision in the specification of competencies is the key to accurate communication of workplace needs:

> For accurate communication of the outcomes of competence and attainment, a precision in the use of language in such statements will need to be established, approaching that of a science. (Jessup 1991, p 134)

Again the narrowness of these representations of this principle have alienated many tertiary educators. However, it is possible to glean, from this and the other principles, some aspects which are progressive and to produce educational design which meets the needs of a range of stakeholders. Also, this interest in greater workplace relevance is not unique to the competency movement although its presence may have been catalytic in increased interest by universities in including professional and industry personnel in review of programme structures and curricula.

During the 1990s, many Australian professional associations, with government assistance, developed competency-based standards for work in their professions and used them in their interactions with universities. Academic respondents to our national study (Bowden and Masters 1993, p 98) were asked to express their views about the involvement in the design of curricula, teaching and assessment in higher education of the following groups: practising professionals, professional associations and employers. The majority of respondents were positive about the current involvement of such groups.

Further conclusions from our national study (Bowden and Masters 1993, p 152), which were derived from data and views provided by professional associations, employers of graduates, university vice-chancellors and their representatives, professional teams engaged in the development of competency standards and university academics, are listed below. The study was focused on the implications for higher education of the development of competency-based standards by the professions.

> The evidence suggests that universities, the professions, employers and the community have much to gain from the activities concerned with the development of competency-based standards by the professions. It is doubtful that these gains will be in exactly the form that some in the competency movement intended but the outcome reflects the fact that the whole process has been dynamic and developmental. However, we do not believe that a full-blown competency-based approach to education will become dominant in university courses.
>
> In developing competency-based standards, one of the benefits for the professions is that they are better able to understand and articulate their professions. Most professional organisations have used the processes of standards development to improve dialogue and relations between themselves and the universities with regard to curricula.
>
> We believe that as a consequence, some of the fears of universities that may have originally been well-founded, can now be put aside; some of the desirable objectives intended by the professions, argued for by many employers and ultimately supported by the university representatives, should be pursued and can be attained. These include greater attention to the links between workplace performance and discipline-based knowledge, increased efforts to address more concretely the attainment of underlying capacities of a generic kind and explicit consideration of the relation among all of these in curriculum development, teaching and learning activities.

> Progress of this kind will best take place in the context of the existing, long-standing and largely successful relationships many universities have with the professions and employer groups through course advisory committees and accreditation processes.
>
> Indeed, if there is one continuing danger both to university education and to professional practice, it is the possibility of bureaucratically inspired external interference in the planning and conduct of professional education.
>
> ... university education in general and professional education in particular are complex processes in which conceptual understanding and practical experience combine to enable the development of the higher order capacities that are called for by employers, governments and the community.
>
> Such complex educational outcomes are likely to be jeopardised by bureaucratic imposition of narrow perspectives, both of professional practice and also of educational processes and outcomes. These are best left to the professions and the universities who can use the experience of the past few years to assist the evolution of better professional, educational programmes that meet both community and individual student needs, not only in the short term but also in the longer term, as circumstances and need change.

The Relation Between Competence and Competencies

Types of Competency-based Approaches

The history of the development of competency-based education and the hierarchy of forms of it go hand in hand. The hierarchy represented in Table 1 shows different perspectives on what represents competence, as implied by different competency-based practices.

Table 3: CBE Levels

0 Generic	Knowledge, skills and attitudes (what the competency-based movement has reacted against)
1 Behaviourist	Basic performance in the workplace
2 Additive	Performance plus knowledge (usually with knowledge assessment undertaken separately from performance assessment, an additive not an integrative approach)
3 Integrative	Performance and knowledge integrated
4 Holistic	Holistic competence (discussed further below)

Gonczi, Hager and Oliver (1990) point out that the analysis of professional work into roles, tasks and sub tasks, results in impractically long lists of specific tasks (Level 1 in Table 1). Attribute analysis on the other hand (Level 0) runs the risk of attempting to spell out the knowledge, skills and attitudes that underlie professional competence without considering what it is that professionals actually do in the workplace. According to Gonczi, Hager and Oliver, the Level 2 approach begins by attempting to identify those areas of professional practice in which it is essential to demonstrate at least minimum competence and to identify the knowledge, skills and attitudes required to perform complex professional activities.

There is a need to differentiate between that additive approach and the Level 3 approach which attempts to consider knowledge in context, in relation to

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performance rather than separate from it, while the Level 4 approach represents the attempt to integrate as well the person's way of seeing himself/herself as a professional. It is more holistic than and subsumes the previous Levels.

There is a series of trends as you move from Level 1 through to Level 4. In the first place, that progression mirrors the historical development of competency-based education. The narrower, performance focused aspects represent the beginning of the movement and, over the decades, some in the movement have revised their thinking and developed practices further, although this has not been universal. The other trends from Level 1 to Level 4 include

- increasing complexity of outcome
- broader curriculum requirements
- more complex assessment requirements,
- increasing ambiguity in the relation between objectives and assessment of outcome, and
- increasing need for interpretation and professional judgement in assessment.

Level 4 for instance represents a three-way integration among the person's way of seeing his/her professional role, his/her capacity to undertake that role and the knowledge-base with which that professional identity and performance are intermeshed. The assessment of such an outcome is not simple and it is difficult to assess it directly.

It is not surprising that, initially, the competency movement focused on minimal ambiguity and greater certainty, viz Level 1. They were concerned to generate greater recognition of the role of education in preparing students for the workplace, within an educational world that they saw as focused on book-learning and theory. As a consequence their terminology and their practices focused almost entirely on the workplace connection. This may or may not have been strategically wise but, whether it was strategic at the time or not, such lower level approaches must be judged in the 1990s on their merits, not on rational motives of decades before. Hence the kinds of shifts in focus espoused by Gonczi and Hager and others are developments that would be expected to take place and some would argue, including myself, that there is even further to go. That is what the next section of this paper is about.

The Nature of Competence

What is competence and how is it related to competencies? The term competency itself has two elements to it. The first is that it appears to be linked to competence in some way and the second is that it is a diminutive, ie it refers to some part of competence. The term is not used consistently although its origins mean that it refers in some way to competence in the workplace. Is a competency the capacity adequately to do some task which, along with other tasks, represents competence in the workplace? Is a competency one of a range of underlying attributes, the possession of which will ensure competence in carrying out workplace activities. Or is the concept of competence more complex than either of these indicates?

It is argued here that the concept of competence is indeed more complex than the definitions considered above and that we must understand its complexity if we are to design educational programmes that properly prepare students for their role in the workplace. Velde and Svensson (1996) provide a review of questions such as those asked in the previous paragraph and cite Gonczi's (1994) classification of different conceptions of the nature of competence. They are the behaviourist (corresponding to Level 1 category above), the generic (equivalent to Level 0) and the holistic (equivalent to Levels 2, 3 which I have labelled additive and integrative respectively, with Level 4 as the one I label holistic). Velde and Svensson also discuss relational notions of competence:

> Gonczi (1994) adds that this (holistic) notion of competence is relational, because it brings together the abilities of individuals and the tasks that need to be performed in particular situations. Jones and Moore (1995:81) use the term 'relational' to "indicate the broader theoretical way in which it attempts to locate competence within contextually located sets of social relations and their cultures of practice..."

Jones and Moore talk about the whole being greater than the sum of the parts and put this view of competence with its cultural characteristics and associations with social practice as a contrast with one which attempts to represent competence in a technical system of prescribed behaviours.

Velde and Svensson summarise the situation thus:

> ...the conception of competence needed to meet the demands of the general situation seems to be a relational, interpretative, holistic and contextual conception. Relational in the sense that it focuses on the relation between an individual (group) and a situation, seeing competence as a holistic quality in this relation. It has to be contextual both in the sense that parts of the relation are understood in relation to the whole and in the sense that the whole qualities of the relation are understood in relation to the nature of the individual and of the situation... what is needed is not only a description of performances which are according to standards but an understanding of the variation in whole characteristics of performances on specific tasks, both successful and unsuccessful performances, as a basis for understanding the relation between more general and more specific parts of competence.

Sandberg (1991, 1994) extends these views of competence by arguing for the inclusion of an intentional dimension, ie the person's conception of the work and his/her relation to it. This corresponds to Level 4 of the earlier categorisation. Sandberg's notion of intentionality is content-related. This means that the general characteristics of competence that have been described acquire their meaning only through consideration of each specific case. What it means to be a competent engineer, a competent doctor, a competent electrician or a competent teacher will be different from each other despite all being characterised by the individual's way of seeing the professional situations. Those meanings have to be learned.

Learning Theory and Competence

Learning for an Unknown Future

It is one thing to argue for the kinds of learning outcomes implied by the particular definitions of competence above which many, including myself, deem as more appropriate for describing performance in the workplace. It is quite another to suggest mechanisms by which such high level outcomes might be achieved. A theory of learning is needed which accounts for the ways in which learning experiences may be designed so that these particular learning outcomes are more likely to be achieved. Ference Marton (1996) addresses this issue in a way that reflects Sandberg's view of competence:

> Studies in higher education are supposed to enable students to deal with situations in the future which cannot be defined in advance. By means of appropriating what is known, students are expected to be equipped for dealing with the unknown. This can be achieved by forming the eyes through which students are going to see situations in their professional lives in the future.

What tertiary educators must face is that students need to experience a curriculum related to a particular area of study which will enable them to develop the capacity to perform after graduation in circumstances that can't be prescribed in advance. On the one hand, it is too difficult to reproduce the specific contexts that a particular graduate will later confront. Students need to learn in ways that help them deal with a range of contexts, many if not all unique. Secondly, the world advances every day and no preparation for experiences some years ahead can rely on the accuracy of any forecasting of such advances. So university education has to be, as Marton suggests, about learning for an unknown future.

Learning physics concepts

This section is focused on a technological learning topic, viz understanding of concepts such as force and acceleration, which has been the object of my own research in recent years. Typically in a physics course at senior secondary school or first year university, concepts of force and acceleration are exemplified through problem sets featuring, for instance, motor vehicles travelling along roads or trains on railway tracks. Students are asked to solve many problems of the kind that require calculation, say, of the acceleration of a vehicle which increases its velocity from zero to 50 kph in ten seconds. Some relevant equations (which I learned off by heart over thirty years ago) are

$v = u + at$ $s = ut + 0.5$ at^2 $v^2 = u^2 + 2as$

with "u" being the initial velocity, "v" the final velocity, "a" the acceleration, "t" the time elapsed and "s" the displacement.

What I remember doing those decades ago, unhappily in retrospect, was to ask myself which of u, v, a, t and s had numerical values provided in the problem description, which variable was needed in the answer and then to choose the equation with that complete set of variables in it. In a sense, what acceleration meant to me was "the answer to the solution of the relevant equation". Slightly more scientific than that, it also had a meaning associated with changing (usually increasing) speed. These understandings were reinforced by the large number of problems of just this kind that we did and by the fact that those problems inevitably turned up in the examination papers.

The assumptions that are required to solve problems such as those described above are that any acceleration being calculated is uniform or constant, that the vehicle is travelling on a straight, flat surface and that other forces such as wind resistance should be ignored. One of the difficulties in helping students learn about force and acceleration using this kind of curriculum is that such assumptions are unlikely to be encountered in real-life situations.

Lest you think that this minimalist approach to teaching and learning is likely to be a characteristic only of inferior educational institutions or less able students, you should know about an Australian Research Council funded research project that we undertook because later year students in a university physics course were having difficulty with advanced study despite performing very well in physics examinations in final year of school and first year at university (see Bowden et al, 1992; Dall'Alba et al. 1993; Walsh et al. 1993). The university was a prestigious one always ranked in the top group on any national ratings scale and the students entered the university with secondary school grades higher than any other cohort entering physics courses elsewhere in the region.

In our research, we asked students to solve physics problems, some of which were quantitative and others of which were qualitative problems without any numerical answers possible. Students were always asked to explain how and why. We found the anticipated result that, while there was a range in capacity to solve the quantitative problems, many students had little or no difficulty at all with numerical problems. In contrast, few students were able to deal adequately with the qualitative problems. Further, even when students were able to solve the quantitative problems, their qualitative explanations often lacked scientific rigour.

For instance, in one of the qualitative problems, we described a situation in which a parachutist jumps from an aircraft and opens the parachute after a few seconds. We asked each student to tell us what would happen from the moment the parachutist left the aircraft and to explain why.

The scientific explanation for the motion prior to the opening of the parachute is that the force due to gravity causes the parachutist to move towards the earth at an increasing velocity. However, the parachutist doesn't accelerate (increase velocity) indefinitely. In fact, a parachutist would be moving towards the ground after falling, say, two thousand metres, at the same velocity as after just one thousand metres. Why is this so? The reason is that as the parachutist falls faster and faster, the air resistance gets greater; the faster you fall through the air, the more force the air exerts on your body in a direction opposite to your movement. That force is exerted upwards, opposite to the effect of gravity. So as you get faster, the magnitude of the force of air resistance gets closer to that of gravity and your overall acceleration diminishes, ie the rate at which your velocity is increasing is slowing. Eventually the acceleration becomes zero when the force of gravity and the air resistance are equal. With your acceleration zero, your velocity remains constant. Thus you continue to fall at that constant velocity which has been given the name 'terminal velocity'.

Few students in our study were able to explain the parachutist's motion in this way despite being able to calculate answers to quantitative problems depicting similar situations. Many were aware of the influence of gravity on the parachutist's velocity and they were also aware of the effect of air resistance on velocity but they often responded as if these two aspects were not related. They tended to deal with them independently but not together.

Underlying all our results was the finding that descriptions of students' understanding of fundamental concepts such as force and acceleration cover a range of categories and that many of these understandings have much less explanatory power than the accepted scientific explanation. An important aspect of that is that many students who were unable to explain adequately the underlying scientific principles still could perform the quantitative tasks perfectly, provided they could be addressed simply by using memorised equations. So here we have an example of students being able to do something, to carry out a required task, but who are unable to cope with problems outside a narrow spectrum and unable to explain adequately why the solutions work. Some members of this particular university were among the most vocal opponents of the competency movement in Australia in the 90s and yet this particular approach to education has all the hallmarks of what I would regard as the unacceptable face of competency-based education. In a way Level 0 and Level 1 of the hierarchy described earlier are mirror images of each other. They are both concerned with performance and they are both narrow and limited, but with a different focus.

Marton's Variation Theory

Clearly most students who participated in our study didn't appear to be developing the capacity to deal with novel situations in very effective ways. They could cope with problems that were very similar to others they had learned to solve but they were able neither to explain why those solutions worked nor to deal with problems that were presented in formats they hadn't experienced before. They had not developed what Marton (1996) has referred to as a professional "way of seeing" novel situations.

What is this professional way of seeing? What is it that makes one worker more competent than another who perhaps possesses the same knowledge and skills? The question can be turned around to ask how it is that when confronted with a novel situation, the more competent person knows what aspects of their knowledge and skills are relevant to the situation.

Every phenomenon has a large number of aspects.

> The aspects and the relations between them that are discerned and simultaneously present in the individual's focal awareness define the individual's way of experiencing the phenomenon. Being focally aware of the weight of a body immersed in some fluid as compared to its weight when not immersed, of the fact that a certain volume of fluid is displaced by the act of immersion, of the weight of the fluid displaced—all at the same time—amounts to what it takes to discover, or to understand, Archimedes principle. The key aspect is the set of different aspects which are simultaneously present in focal awareness (Marton and Booth 1997)

To be competent in dealing with workplace situations, it is necessary to discern and be aware of all relevant aspects of the phenomenon and of the situation simultaneously. It is in this way that the competent worker is able to know what knowledge and skills are relevant. In the parachutist example described above, many students had awareness of both the gravity and air resistance aspects separately but not simultaneously. The next question to be asked is how that capacity to discern the relevant aspects can be developed.

Language Acquisition

It is interesting to speculate on the ways in which, on the one hand, a baby learns to speak and to understand language and, on the other, the ways graduates learn to be professionally competent. It would be useful to be able to explain both forms of human learning without having to describe a separate theory for each. Let me explore that a little.

Consider the way a baby learns to understand and use language (this example is an adaptation of an analysis by Ference Marton [in press]). The experiences a baby has with language are frequent and one would expect bewildering. Some people around the baby talk to each other in ways that ignore the infant. Most at some time speak to the infant and, especially when the speaker is the mother or other family members, language is often accompanied by other behaviours such as touching or providing food, many of which are positive but some of which are negative.

However, the aural experiences a baby has are not consistent or uniform. When a mother utters certain words, they may be linked with a happy frame of mind and associated behaviour. When a father or sibling utters the same words, their utterances will certainly have different aural characteristics and they may or may not be associated with the same behaviours. Further, different people are likely to utter different words even when engaged in the same behaviour; they speak to the baby from different distances, with varying loudness. So how does the baby manage to acquire language?

It could be said that with all that variation, all that inconsistency, it is a wonder that a baby learns to speak at all. Marton argues that, in fact, it is the variation itself in the experience a baby has which enables it to understand and use language.

Marton has devised a thought experiment to illustrate this point. Close your eyes for a moment and imagine the unthinkable—a new-born baby being cared for by robots. These robots can look after the physical needs of the baby but they also have speech recognition capacity and are fitted with speech synthesisers. Spoken words accompany all of their actions. Imagine, say after twelve or eighteen months, that the baby's parents enter the room and begin to speak to the baby using only the vocabulary which was available to the robots—i.e. no new words. Would the baby be able to understand what its parents are saying?

Well, the baby would not understand its parents very well in such circumstances. And the reason it would not is related to the uniformity of the baby's experience with the robots. What happens in normal circumstances is that the variation in a baby's experience is just what enables it to differentiate the common, essential features of language structure from the idiosyncratic aspects associated with each individual's speech. It is what enables babies to experiment with language and to infer rules. It is what enables babies to hear something with different aural characteristics but nevertheless interpret it within the inferred structure. The baby reared by robots would have a language of a kind but it would not be anywhere near as robust, as differentiated or as useful as a baby raised normally would possess.

Variation theory applied to technological learning

What is the relevance of this account of language acquisition? Marton (in press) suggests that the way we learn in order to be able to cope with the unknown future is to learn variation:

> We learn to know people, mother tongue, phenomena, situations through variation in appearance, sound-pattern, perspectives, important parameters. As

> we learn the variation, we also learn about situations that we have never encountered and about phenomena in ways we have never seen them—they can be made sense of in terms of the variation that we have learned as not as yet realised potentialities. ...the more narrow the range of situations, problems, appearances of phenomena, points of view, perspectives that we have encountered in our studies are, the less likely we will be capable of dealing with novel situations, new appearances, other points of view, other perspectives.

Marton's variation theory would suggest that students' understanding of scientific principles and capacity to explain a variety of real-life contexts would be enhanced by including well designed contextual variation in the learning experience. Far better to expose students to a variety of situations (see Figure 1) which are designed to develop the capacity to discern the relevant aspects of the situation.

Figure 1(a) depicts the idealised context for consideration of force and acceleration that is the subject of so many textbook treatments, a vehicle moving on a flat, straight surface. This is almost an invariant context. The normal variations we experience in real life are artificially removed. The difficulty for students is that if the artificiality of this context is not made visible by consideration of the same concepts in more real-life contexts, then the capacity to deal with novel contexts will not be developed. And this is what we found in our research study.

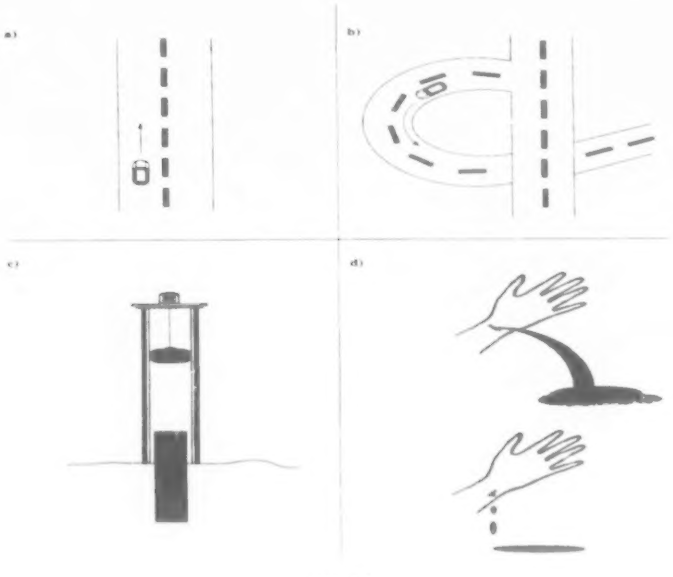

Figure 1

There are contexts which are more commonly encountered and which can be used to develop students' understandings of force and acceleration. These are shown in Figure 1(b), (c) and (d). The diagrams and contexts they depict are schematic and it is not suggested that they represent an appropriate curriculum. However, they do demonstrate the idea of variation and its contribution to the development of discernment of the relevant aspects of a phenomenon and are used here only for that purpose.

Figure 1(b) depicts a car driving on a ramp leading to a freeway. This context raises a number of questions:

- why do some drivers cause their cars to become slower and slower as they move down and around the ramp?
- is the car easier or harder to control if the accelerator pedal is depressed a little more as the car moves around the ramp?
- what is the relation between acceleration and the changing of direction, with or without constant speed?

In fact, the concepts of force and acceleration are not related only to changes in speed. The term velocity is used in physics rather than the term speed to denote the inclusion of the directional aspect. Not only does it take force to increase the speed of a body but it also requires force to change its direction, with the speed held constant. Hence if the accelerator pedal of the car moving around the ramp in Figure 1(b) is pressed down a little further, there can be sufficient force to bring about a change in direction without affecting the speed. However, if the pedal is not pressed down further, the speed will decrease as the direction of the motion changes around the curving ramp; the car slows down. (Even this is a simplification because transverse motion and road-tyre friction can also come into play. Nevertheless, the essential argument above stands.)

What this context does is to encourage a more sophisticated understanding of acceleration and force to develop - one whose relevance structure is more complex so that it includes the direction of motion as well as the speed.

Figure 1(c) shows the use of a pile-driver. This diagram is merely a schematic one and a real pile driver is more complex. Nevertheless this provides sufficient aspects to illustrate the points being made. Basically a pile driver consists of a frame supporting a weight held some distance above a pile which is wedged in the ground. The weight is released and it falls towards the pile. When it hits the pile the two move down together and the pile is wedged further into the ground until the pile and weight come to rest.

This context raises questions which test the useful limits of the concept of acceleration:

- is the motion of the descending weight the same as or different from that of the parachutist in free fall described earlier?
- what forces are affecting the motion of the descending weight in free flight and what is its acceleration?
- when the weight hits the pile, they appear to move instantaneously together at a velocity much less than that of the weight before impact; can this be a case of infinite acceleration or have we reached the limits of applicability of the concept?
- is there some other explanation involving new concepts such as impulse and conservation of momentum that is more appropriate?

Most of the relevant issues are found in the questions above. Indeed, the answer to the first two questions is that the motion of the falling weight and the parachutist in free flight can be explained by the same scientific principles. And yes, there is a need to use new concepts to describe the motion of the combined weight and pile.

What needs to be explained is how it is that the pile is sitting at rest and, then, instantaneously, it is moving. A relevant aspect of acceleration not yet dealt with is that it is concerned with the rate of change of velocity, ie not just with the amount of change in velocity but also how quickly the velocity changes. The average acceleration is the change in velocity divided by the time taken for the change to occur. With the pile driver, it appears that the pile instantaneously goes from rest to some finite velocity. This implies infinite acceleration; some other way of dealing with this context is necessary. The concept of impulse and conservation of momentum principles are introduced to provide a full explanation of this phenomenon. So this context both introduces a new aspect and also demonstrates some limits to the usefulness of the concepts of force and acceleration as explanations of such motion. In that way, the understanding of these concepts is enhanced and their relation to the new concepts developed. The expectation would be that the learner would develop a greater capacity to discern the relevant aspects of this and other situations.

Figure 1(d) merely depicts the different way that blood flows from a punctured vein and a punctured artery in the human body. When the blood from the artery spurts out it is moving faster than the blood which oozes more slowly from a vein. The motion of drops of blood falling to the ground from the puncture in each of the two cases can be explained in the terms already described for the parachutist. But what about the motion of blood circulating around the body in unpunctured arteries and veins? Does the behaviour of the blood coming from the punctured blood vessels reveal different motion within the closed systems? In particular,

- does the blood flow more slowly in a vein than in an artery?
- does the blood flow more rapidly down the body than up the body due to the influence of gravity?
- are the concepts of acceleration as applied to falling bodies like parachutists and pile drivers relevant when the object is a fluid?

Well, this is an even more complex situation than any of the others so far and the fact that the blood flow is not constant (related to the pumping of the heart), that there are valves in the system and that it is a closed fluid system (think of the effect of the opening of a household tap on the level of water in a reservoir many miles away) make simple analysis using the concepts of force and acceleration impossible. Again this points to the need to deal with new concepts such as pressure and adds to the understanding of force and acceleration through their relationship to such new concepts.

You will note that most of the questions that have been posed invite qualitative answers. Our research showed that the ability to provide the right answer to quantitative questions often masks the understanding of the underlying concepts and students are not challenged or encouraged by such questions to reflect on and modify their understandings. Qualitative questions and discussion are essential for conceptual development.

It should be pointed out that the context depicted in Figure 1(b) involves the idea of circular motion and the context depicted in Figure 1(d) involves fluid motion. Now some physicists who are reading this account will say, quite correctly, that in physics subjects, circular motion or rotational mechanics is often taught; so too is fluid mechanics. The trouble is that those topics are usually taught as separate idealised systems, separate from each other and from basic mechanics. Students who can solve the basic mechanics problems described earlier often also become adept at solving the quantitative problems involving rotational mechanics, using yet another set of memorised equations. But they commonly fail to integrate the experiences in a way which enriches their understanding of force and acceleration or develops their capacity to discern the relevant aspects of novel situations involving those concepts.

Figure 2 illustrates this point. In Figure 2 (a), the real life phenomenon P, as depicted, is less likely to be understood if each of the contextual variations is treated in the curriculum as a special case with lots of contemporary experiences being required which focus on that one aspect. So clumps of specialised knowledge or skill are acquired and the way of solving a problem is to see if it fits one of the clumps. When it doesn't, there is difficulty in solving the problem.

However if the changing context, the variation in experience described earlier, is treated as part of the problem solution, then the contextual differences associated with phenomenon P, become merely one aspect of the problem which students have become used to including and dealing with. It is part of their way of seeing themselves as scientists.

It should be emphasised that what is being argued here is not simply that there should be a wide range of relevant examples provided which in some way capture the range of student interest. It is not being argued that basic physics subjects should be made relevant for students of nursing, say, by replacing some of the standard "motor cars on a straight flat road" type problems with problems concerned with "wheelchairs moving down a hospital corridor" or the like. Rather, the different contexts should be chosen so that different aspects of, say in this case force and acceleration, come into focus from one context to the other. The contexts in Figure 1 provide that kind of variation and in doing so assist the student to develop a more comprehensive and differentiated understanding of the concept and the contexts in which different aspects are more or less relevant. Perhaps more importantly, they can lead students to the conclusion that there are contexts in which other concepts become more relevant and can facilitate an even broader understanding of the whole subject in a relational way. As Dall'Alba and Sandberg (1992) express it

> ...students learn skills and knowledge in accordance with their developing conception of the content related to the profession. Hence, in order that students master the necessary knowledge and skills, they must learn to conceptualise the content in ways that are appropriate to the aims of education and to the profession.

So it matters what kinds of learning experiences students have and the responsibility of teaching goes beyond simple specification of topics to be covered. Attention needs to be given to the ways that students see the content, ie Marton's "forming the eyes" through which students will be dealing with the future, and the example given above of contexts demonstrating aspects of force and acceleration is just that, one example. Course teams need to devise appropriate

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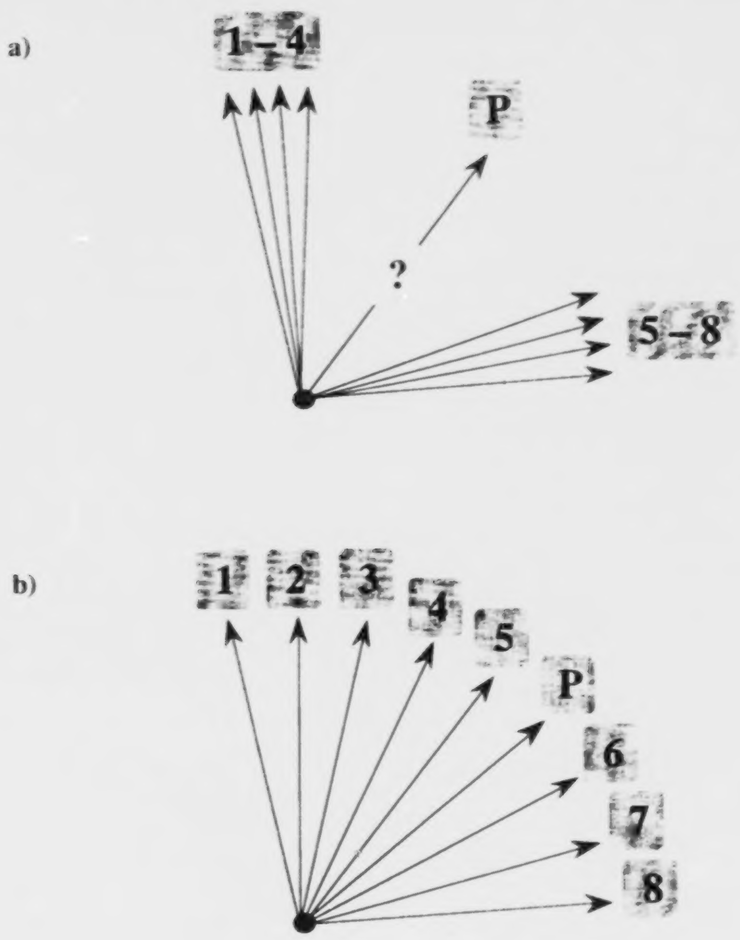
variations in learning experiences in their programmes so that students develop in ways that enable them to become competent professionals who can discern the relevant aspects of novel situations.



Concepts in a Range of Contexts

Figure 2

Some Consequences

While the explanation of such an approach based on Marton's variation theory may be new, I am not suggesting that such practices do not already exist in some educational programmes. The value placed by the competency movement on work-based learning and the widespread interest by university educators in providing learning experiences focused on field work, projects and work placement are all explicable in terms of the theoretical argument above. However the variation has to be experienced. The example above of basic mechanics, circular motion and fluid mechanics being dealt with in a curriculum as isolated issues does not represent experienced variation.

So too can Marton's variation theory account for (as of course can novice-expert theories) the fact that "experience" is so important in developing expertise and why we tend in real life to devalue the "narrow" expert. The experts we value can readily home in on the most important aspects of any situation they confront. Their expertise is based on growth through integration of a range of experiences of different contexts with each helping to build an increasing capacity to understand various situations and form professional judgements. This links to Figure 2(b). On the other hand, experts in a narrow field or fields whose understandings have been developed in isolation as depicted in Figure 2(a), will not develop such judgement. They see their role differently; they act differently. I would suggest that these two types of experience lead to different levels of competence and that the former is related more with Level 4 described earlier and the latter with the inferior Levels 1 and 2.

Another concern I have is about the notion of transfer or application of knowledge. The meaning normally ascribed to those terms, that students learn all about a concept in one context and then apply it to a different context, is a doubtful one. Rather, learning about the concept should transcend a range of relevant contexts so that students develop knowledge-in-context. They see the knowledge as relational, ie context-dependent, and they become comfortable with dealing with the concept in a range of contexts because they have developed the capacity to judge what aspects of the concept are relevant to the particular context.

Now for universities which oppose all ideas associated with competency-based education, there is a salutary lesson. The relation between theoretical concepts and their real-life representations is an essential feature of this "variation" approach. By the same token, for advocates of competency-based approaches, the "learning a hundred skills" Level 1 format should be questioned. How do you arrange competency-based learning so that students become prepared for an unknown world? The answer lies not at, but somewhere between, the extremes. It must involve a concern for workplace performance outcomes, but not exclusively nor in isolation.

Concluding Summary

This paper has provided a brief history of the competency movement and has argued that a rational analysis of the principles underpinning a competency-based approach to education should be undertaken so that the valuable aspects can contribute to our understanding of tertiary education in the 1990s.

The notion of competence in the workplace has been explored and it has been concluded that a key aspect of competence is the person's way of seeing particular situations that confront them in their workplace role. It is through these ways of seeing that the person can call on relevant aspects of the integrated knowledge and skills they have learned to deal with the variation in their work situation.

It has been argued that, since the future work situations that today's students will be dealing with cannot be prescribed, students need to learn in ways which develop their capacity to discern the relevant aspects of relatively novel situations. It is suggested that this is best achieved by including contextual variation as part of the learning experience. As Marton (in press) states: "In order to become capable of dealing with a varying future we must have met a varying past".

Competency-based approaches must therefore be adapted to deal with this unpredictable future by moving away from the prescriptiveness of earlier and less helpful versions and by embracing the principles of variation argued for in this paper. Further detail on these matters and on the crucial issue of assessment which has not been dealt with here, will be provided in a forthcoming publication by Bowden and Marton.

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Reforming Technological Education—
Imperatives for Change

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Your Excellencies, delegates, ladies and gentlemen; it's a pleasure and a privilege for me to be here. It's a pleasure because I've never visited the Emirates before and the hospitality is overwhelming. It's a privilege because the opportunity to hear so many distinguished colleagues is rare, and particularly to hear so many colleagues from an academic background. My background is in industry and employment and not in academia. I therefore am going to talk to you practically, about what happened in the UK and a little bit about what we've done and why we've done it .

We start 20 years ago. You'll be relieved to know, I'm not going to work through the 20 years, a year at a time. 20 years ago we had an education and training system in the UK which was based on primary industries which were in decline - extractive industries, coal mining, iron and steel production and heavy engineering ship building. We were in many of those and in other developing sectors, and internationally uncompetitive. You heard this morning reference to some of the studies in the 1980s which compared to a German performance and a British performance in a number of sectors in industry which demonstrated that.

We had an education system which was elitist, which was designed to identify and cultivate the small proportion of the population who were very able. When you have large primary industries, of course, that's what you need. You need a small number of clever people to decide what to do and a very large number of people who are not very clever, who need to do what they are told. As you move away from that into modern industries, and into the service sector, you need a very different kind of working population.

We also had in the UK, and to some extent still have, a culture which is probably best described as anti-vocational. That goes back a long way to the time when ladies and gentlemen didn't work. Work was for the working classes and qualifications for work and training, for work was something that was done only by the masses and not by those in positions or influence.

That's a long standing cultural thing in the UK. Whilst we've made some progress in changing that in the past 20 years, it's certainly going to take the rest of my life, and I suspect a few years more, before we get the right balance in values between those things associated with culture and learning, and those things associated with work.

We undertook a number of major reforms in that time, two of which I will not deal with in any detail. We introduced for the first time a national curriculum, up until the late 80s, what was taught in our schools right up to the upper secondary level, to the school leaving age of 16, was largely at the discretion of individual teachers and individual schools. It was only in the late 80s that we introduced a national curriculum that laid down the standards in the core subjects of English, mathematics, science and a foreign language. We also radically expanded our higher education provision. In the 1970s, less than 10% of each age group were going to university, now over 30% are going.

Now, the things I want to spend a little time on are the two reforms that my Council has been responsible for. The introduction of the national vocational qualifications (NVQ) system and general national vocational qualifications (GNVQ). I need to say a little less about either of those than I might have done partly because you have already heard about some of the experiences in Oman, where both of those have been introduced as the national systems, and other developments too in the Gulf. In Bahrain a similar decision is in the process of being taken. You've also heard David Stern earlier this morning giving a similar account of what the GNVQ does.

Perhaps what's important, is what underlies all of those reforms. First of all our reliance of the specifications of outcome. Outcomes in different forms depending on the circumstances. Much of our higher education, for example, is specified in terms of learning and outcomes. Our national curriculum is specified in terms of achievement targets for young people. GNVQs and NVQs are specified, in the case of GNVQs, in learning outcomes, and in the case of NVQs, in performance outcomes in the work place.

Secondly, and arising from that, is much greater autonomy for institutions, whether those are schools, colleges, providers of training or universities. There is a liberating effect from basing your national system on outcomes and not prescribing how things should be taught, how they should be learnt, in what order they should be done, or how long they should take. That involves something of a gamble. It does involve putting a lot of faith in those who teach and those who facilitate learning. It involves too, the concept of choice and an experience of perhaps a different philosophy, to that which we heard yesterday from Singapore, where our system is based on the concept of individual choice and there is no central manpower planning - no social engineering which determines how many people are educated and trained, and in what discipline, or what occupation or sector.

There is an underlying philosophy that is to allow the individual to choose, given appropriate guidance. The systems are inclusive rather than exclusive. We're tending to move away from our old idea that, what education was about, was simply identifying the best and investing in them, to a system in which we are trying to identify and develop the best in everyone.

Finally, transparency. Transparency of the outcomes, absolute clarity about what particular programmes, what particular institutions are intending to choose. Clarity over institutional performance. The publication of data about what education and training institutions have achieved in terms of qualification results that their students achieve.

Let me talk a little about the two systems for which I'm responsible. First of all the NVQ system. I will deal with this briefly as you will have more opportunity tomorrow to hear from my colleague, Gordon Beaumont, who is conducting an extensive review of the NVQ system. Just let me highlight one or two of its principle features.

First of all, it is an employment-led system. What that means is that the standards on which the qualifications are based, are determined by employers to meet the needs of employment. That again is a gamble on the part of the government. It involves handing over power over what the content is, to those who have to live with the outcome. That is a courageous thing for governments to do. Governments on the whole don't like giving up power and handing it to others. It's a vital component of the system which is designed to meet the needs of employment.

One other thing about that, and it is interesting I think, in the context of a conference organised by the HCT, is the kind of occupational balance that emerges from that sort of process. Technology is very important, but certainly in our economy, far more people are employed in essentially non-technological work - in services of various kinds: personal services, financial services, distributive services. I was interested to hear last night that, in the non-oil sector of the UAE economy sector, the largest and fastest growing sector is that of services, leisure and tourism. It's important to recognise therefore, that that is where employment growth, in numerical terms, is likely to come, and very important not to neglect those areas, and indeed the application of technology to those areas.

Secondly, the system is competence based. John Bowden has given an excellent account of what competence based means and how it has developed over the years. Our qualifications are based on occupational standards, determined by employers and employment representatives, which are designed to reflect the full demands of employment. Therefore they aspire to be holistic standards. I wouldn't claim that all of them are perfect, as we've only been doing it for ten years, and that isn't long enough to get the standards anywhere near right—but they aspire to be holistic standards of competence.

We have standards now that govern 90% of the occupations of the UK. One other interesting thing David Stern mentioned was the comparison between Britain and Germany. In the German dual systems, there are 376 occupations identified at a comparable level. In our system there are 103, and that is a very interesting demonstration of how thinking has moved in the definitions. 20 or 30 years ago, when the dual system had started, occupations were defined on a much narrower basis than they are now being defined.

Finally, the system is designed for open access, not just for young people. It is designed for access for people throughout their working lives, designed for people who don't necessarily have the time for full-time educational training, designed for people who are at some disadvantage in the labour market, whether because they lack the basic education and training they need to succeed or whether because history or prejudice has kept them out of particular occupations.

The GNVQ system is a later development that's been operating now really only for five years and is designed primarily, although not exclusively, for young people. It is designed to facilitate progression into employment and for those who are capable of it, into higher education. It's based on active learning. It's based on learning by doing. It's related closely to the needs of employment. The standards in GNVQS are related to the standards in NVQs. It uses a whole range of approaches to assessment, relies both on assessing students' work as they do it and on more traditional external assessment. It is also a progressive qualification. It operates at three levels so that it is possible to pick up at the age of 16, the compulsory school leaving age, at a level which is appropriate, and move through to the advanced level, which is the highest level, and which will give university entry if it is achieved.

Just a few facts and figures about the two systems before I leave them. NVQs were first awarded in 1990 when there were about 3000 awards made. In 1996, 300,000 were awarded, and we estimate that there are up to 3,000,000 people in the UK now engaged with this system. The growth rate in certification is at the moment 50% a year, and perhaps most significantly, well over half, more than 60% of the people taking NVQs are adults in work or adults seeking work. It is designed as a life-time learning system. It is not just a system for young people.

GNVQs started in 1992 when 8,000 young people took part in a pilot. Last September, 200,000 young people embarked on GNVQ courses. That's about a third of our sixeen-year old age group—a remarkable growth rate and a quite astonishing indication of the need for that kind of intervention in the system. GNVQs are offered now in nearly 3,000 schools and colleges and, as you already heard this morning, the success rate at the advanced level, for those applying for higher education, is over 90%.

We are also now experimenting with using the GNVQs for under sixteen year olds within compulsory schooling as an alternative to more academic education. We have a pilot running in about 150 schools, which is designed by next year to be available in all secondary schools. That's 4,000 secondary schools. So what that gives young people is a set of choices, and remember that I said the choices are an underpinning factor in the system. At 16 they can choose to follow a purely academic route, the traditional "A" levels which gives university entry. They can choose the general route, the GNVQ, and parallel qualifications, or they can choose a vocational route, studying in the work place to reach NVQ standards.

In each of those routes though, we are now seeking to achieve that, in addition to their mainstream study. They also achieve, in what we have come to call, "key-skills" in communicating, in using numbers, and in using information technology. There is a number of reasons for that as not all young people achieve a satisfactory standard in those things by the end of their compulsory schooling. There is remedial work to be done, post-16. Not only that, the abilities to apply theoretical understanding of the language, of numbers and of information technology to practical context, is the basis on which people can become able to transfer what they have learnt from one context to another.

Particularly important in the light of what we have heard yesterday about the twenty-first century technology, you remember two-thirds of it has not even been invented as yet. We could extend that to indicate that two-thirds of occupations that will be needed in the twenty-first century have not been invented yet. It's also important to reflect on the fact that some things don't change in occupational terms. They might be quite boring things like double entry bookkeeping and the calculation of profit and loss but they've been there for over 200 to 300 years and they will still be three in 100 years time. Personal service will still be a requirement in many occupations, customer service is of growing importance and will not go away as an element of competence.

Management, whether it's management of yourself, management of resources or management of others, will not go away as a component of competence. So

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although technology does change and will change faster in the future, there are constants in occupational terms which will not.

Underlying those choices for young people at 16 are some really much more important ones. A simple choice about subject matter: do you study geography or do you study leisure and tourism, or do you train to become an administrator in a tour operator? All related in some way but offering very different subject matter. How do you want to learn? Do you want to learn largely passively, by sitting and listening, or do you want to learn actively, do you want to learn on your own, or do you want to learn in a group?

How do you want to be assessed? Do you want to be assessed through traditional long written examinations, or do you want to be assessed as you go? How fast do you want to go? Do you want to go into a sprint at 16 and go as fast and far as you can or do you want to pace yourself? Do you want to jog rather than sprint through your working life? How do you want to relate to the people who are responsible for your learning? Do you want a dependent relationship, or do you want one in which they are there to facilitate you, but you are in control of the process? Where do you want to learn? Are you happiest learning in the familiar environment of a school, or in the more exciting and stimulating one of a further education college, or do you learn best at work, with adults and with other people who are competent?

All of those are important choices and it is not a simple choice of programme and subject matter. People need of course, to understand their choices before they can make them. We have a long way to go yet in getting people to understand that choices that they are able to make and in getting institutions which are flexible enough to deliver all of those choices. There is a tremendous challenge and a tremendous opportunity for education and training institutions in all of this, and I'm afraid a great deal of hard work in realising its potential.

So what we are seeking and what we have gone some way towards achieving, is a system which involves challenging opportunities for all. Clearly specified, adapted to the learners' needs, and rigorously assessed. Challenging, because we are not seeking a system in which there are any soft options. We are seeking a system in which there is diversity but there is parity of esteem. The opportunities, because we are not seeking a system which sets up barriers, we are seeking to open up opportunities. It is a system for all because it is designed to be inclusive and not exclusive. It is designed to allow each individual to realise their potential.

Creating Motivating Interactive Learning Environments

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Abstract

The convergence of technologies which allow the representation of ideas in many different media formats and the growth of new learning frameworks have created new challenges for learning software development. This presentation will demonstrate the options for creating more effective use of the technology especially as it challenges students and encourages higher order thinking. Whether it be Web or CD-ROM technology learning environments, the representation of ideas with not only text and pictures but also dynamic models of relationships between variables, and information displays in multiple media forms, will be demonstrated as providing challenges for higher education. Several award-winning interactive learning products developed by the team at the University of Wollongong will be employed to emphasise how problem solving challenges for the learners can be incorporated into software products. Special discussion will focus on the use of cognitive support tools to assist learners when they are faced with complex scenarios which might have multiple solutions.

Changes in technologies and their application to education have created some interesting challenges for traditional teaching and for the educational institution. We are no longer talking simply about the use of authored software which can be employed to introduce specific concepts, but increasingly we also require students to select information from a myriad of resources, to examine each for its authority, and to identify which elements they will include in their own constructed responses about the problem or issue. The push to develop information literacy skills is not simply a reaction to the increasing quantity of information sources, but a necessary response to improve the quality of the interpretation of the world based on these and personally developed resources.

Reviewing the Underpinning of our Work as Educators

The starting point for the development of instructional technologies was the belief that the instructor was designing a learning experience for a group of students. All the construction of meaning and the best way to represent concepts and ideas was undertaken by the instructor or designer. Essentially the models of communication employed were teacher to student and prescribed sets of activities for the students in which they practised the required concept. The rise in cognitive approaches to learning during the seventies has re-focused this relationship so that we now view the learning environment as something the learner has a major impact upon, the process has to include the learner as an active participant. Thus we can place the learner in a variety of contexts and provide them with a number of different views of the learning process through which they come to know about the world.

As part of this reassessment of the range of resources and how they contribute to understanding, the conceptions of learning which predominate amongst instructors are also being re-examined. Consider the views offered by Säljö (1979):

1. Learning is acquiring information or 'knowing a lot..'
2. Learning is storing information that can be reproduced.
3. Learning is acquiring facts, skills and methods that can be retained and used as necessary.
4. Learning is making sense or abstracting meaning, relating parts of the subject matter to each other and to the real world.
5. Learning is interpreting and understanding reality in a different way. Learning involves comprehending the world by reinterpreting knowledge.
6. Learning involves comprehending the world by reinterpreting knowledge.

There is a qualitative difference in these views. They move from the sponge view to a view which requires the learners to work actively to understand the evidence they receive from the world and be aware of any framework or process which they apply to its interpretation. This latter view has been linked with theoretical views such as constructivism to produce design guidelines which challenge the framework of instructional technologies. Consider Marcy Driscoll's, (1994) list of five instructional design goals:

1. Provide complex learning environments that incorporate authentic activity.
2. Provide for social negotiation as an integral part of learning to allow insights to emerge through the group process that may not come about otherwise.
3. Juxtapose instructional content and include access to multiple modes of representation to allow learners to examine materials from multiple perspectives.
4. Nurture reflexivity, or awareness of one's own thinking and learning processes.
5. Emphasise student centred instruction, where students are actively involved in determining their own learning needs and how those needs can be met.

The teacher, the learner and the technology options

In moving toward such goals, we are faced with a variety of technologies and strategies. In this discussion, the challenge is to devise innovative and motivating applications of technologies regardless of their specific hardware format. It does not matter whether the learning environment be CD-ROM or Web based, it has to be designed to enable both learners and instructors to function in a number of roles. Consider the options available within a networked learning environment. At one extreme we have the typical classroom, where the teacher and learner share the same space at the same time and learners may work individually or in groups. At the other extreme, the teacher and learner are at different venues, communicate asynchronously and learners may or may not congregate to share their experiences or collaborate/co-operate with learning tasks. The ability for teachers and learners to find a position somewhere along that continuum has been largely facilitated by developments in information technology—a field which incorporates communications, computer and audio-visual technologies.

The multitude of ways the teacher and learner can communicate and the time and feedback quality of those communications largely determine the success of the teacher/learner relationship and the learning outcomes. The move to provide electronic services through fibre optics directly into the home supports the ability to communicate using video, sound and text. Future growth in open learning study offered commercially is likely increasingly to require capability to move files and information between people in different locations and could become one aspect of the development of domestic interactive multimedia distribution.

Real-time video communication links between each communicating party are not really necessary within normal constraints. Learning can occur off-line when two learners communicate at times which are more convenient to them. Possibly the more important consideration is that information can be shared and be represented through a variety of visual and verbal forms as required. Synchronicity or real-time communications should be subservient to the quality of the information exchanged and the appropriateness of its clarity and representation

The learner as user or producer

Typically, the learner has been regarded as the recipient of information. With developments in educational software and the proliferation of both bounded interactive multimedia titles on CD-ROM and unbounded resources on the Web, the learner usually occupies the role of software user. When the activities of the learner are regarded as the central focus in education (Schank and Cleary, 1995) and emphasis is placed on what they are actually doing when using the software, the question can then be asked: Should the learner be a software user or a software producer?

As a software user, their actions may encompass the full range of activities offered by software designers, from passive guided direction in prescriptive environments through to simulations and open active gathering and re-construction of multimedia resources. What they learn and how widely they use that knowledge, skill or strategy is a function of the context of programme use—the learner extracts from a programme what sense they make of it, not what use the designer intended.

> ...the coherence of the learner's experience in this situation is not tied in essential ways to the instructional designer's intent (no matter how detailed or explicit these intentions are spelled out as instructional objectives) nor to the instructional plan built into the instructional system. Rather, the coherence of the learner's instructional experience is tied to the sense that such a learner constructs out of the actual situation (of which the instructional system is just a part). (Streibel 1991, 123)

If the learner is a software producer, the next question to ask is: Why is the learner producing interactive multimedia software? If their focus is on the development of an interactive multimedia product—whether a CD- ROM title or a Web page, then the emphasis will be on learning about interactive multimedia production as a body of knowledge with an accompanying set of skills a situated and authentic activity which synchronises learning and doing, yet an activity in which the acquisition of content knowledge is a fringe benefit. This equates with designer as learner (Jonassen and Reeves, 1996). In this context, the cognitive load of many production tools may be very high and may require substantial time to "polish" the outcome.

If the emphasis is on the learning which occurs through the process of interactive multimedia construction, learner as designer (Jonassen and Reeves, 1996), then the nature of the product is far less important than the knowledge construction process which the learner experiences along the way. Less emphasis is placed on the refinement of production skills and more emphasis is placed on student initiated design and development with just-in-time skill support. When the focus is upon the process, the cognitive load of the construction tool(s) should be minimal to permit the learner to focus on knowledge construction.

The key activities of teaching and learning do not equate with teacher and student. Both teachers and students are involved in the activities of learning and of teaching, especially in a co-operative or collaborative situation. The distinction is made between use of bounded and unbounded educational interactive multimedia material, such as CD-ROM titles and Web resources, and student production of interactive multimedia. Within the latter category, the reason for production then distinguishes between a focus on product development for purposes of publishing and a focus on the significance of the construction process.

The learner as user

Learning theory has influenced the structure of interactive multimedia CD-ROMs along an instructivist to constructivist continuum (Figure 1). There are many fine examples of software at points on this scale which, when viewed collectively, indicate a number of trends. For the software user, as you move towards the constructivist end of the spectrum, there is an increase in the potential for group interaction as the nature of tasks becomes more complex and learner generated. Group work with CD-ROMs means less workstations are required for each class of students, but this student–to–hardware ratio gain is usually offset by an increased need for teacher/peer support, due to the more complex nature and varied duration of tasks.

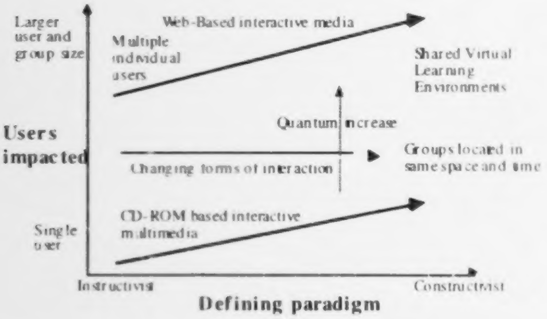
Larger user and group size
Web-Based interactive media
Multiple individual users
Shared Virtual Learning Environments
Quantum increase
Users impacted
Groups located in same space and time
Changing forms of interaction
CD-ROM based interactive multimedia
Single user
Instructivist
Constructivist
Defining paradigm

Figure 1: Comparing the impact and relationships between Interactive (CD-ROM based) Multimedia and Web-based delivery (from Hedberg, Brown & Arrighi, 1997)

The range and extent of user interaction with the data in the software increases as the user is given more freedom to navigate, access, determine the format of information representation and manipulate the data using cognitive and metacognitive tools. All this freedom to access and manipulate data is presented in an information landscape which provides context and support structures. The landscape can be quite extensive and extendable if the aim is to cater for users with a broad range of background knowledge. This degree of flexibility of use means that inbuilt support will tend to be either very situation specific, such as an example, or very generic, indicating potential strategies for software use.

Constructivist software need not be used by a group, however, the individual user in this more democratic environment needs to display the motivation and metacognitive skills of a self-regulated learner to gain maximum benefit from the software without peer support. The group provides a discussion forum for suggestions, ideas and debate, a multitude of learning and problem solving strategies to share, and immediate personal feedback on all communication channels (auditory, visual, body language). Such group benefits are only achieved once group members have acknowledged the need to refine such skills as negotiation and collaboration.

The learner as producer

When individual learners are permitted to occupy the role of interactive multimedia producer with a focus on the knowledge construction process, they are publishing for personal viewing. All the information searching, discussion with peers, mistakes, re-makes, media production, screen construction and linking are vital elements of the process the learner experiences. Immediately they must take an active approach to the appraisal, accumulation and generation of relevant resources.

Low level authoring tools, which place fewer demands on cognitive load than high level production tools, permit the learner rapidly to construct a series of screens. These may undergo many revisions before the underlying structure and interrelationships among concepts are perceived. By externalising this evolving body of knowledge in multimedia format, the constructor can brainstorm, reflect, revise and re-construct what he/she knows at any stage in the overall process.

This building process is not initially driven by principles of interface design, or awareness of a target audience. It is a self-motivated process, driven by the learner's desire to express clearly a concept, usually one screen at a time. The learners have a chance to play with combinations of relevant media which are either self-generated or personally selected, to express ideas in different ways. As concepts are described with increased depth of understanding, clearer interrelationships and overarching concepts may emerge. Eventually the programme may develop a coherent architecture with clear navigation. The constructor generates feedback each time they review and reflect upon the structure and content of their multimedia knowledge base.

A finished product is not important in this process. Frequently at the end of a period of construction, the learners can simply explain how they would publish their ideas in a sophisticated design. The implementation of this design may no longer be matter—the learners are ready to move on.

A teacher watching the evolution of ideas is quickly able to identify what the learners understand well, and what has yet to be clarified. The more clearly a learners understand something, the more simply they can explain it. Great detail and complexity through a "cut and paste" exercise do not necessarily indicate comprehension of the detail. The knowledge construction process for an individual learner can be ongoing. Document editing, linking and synthesis may continue. As the body of information and its associated structure lose coherence for the constructor, he/she must begin the process of re-structuring to incorporate new information. The inner processes of assimilation and accommodation are externalised.

Static or Dynamic Information Sources

The advent of interactive multimedia in its present form of integrated digital forms of representation has enabled individuals to produce software using a variety of different ways of representing and combining their ideas. Teachers may present their students with a world of highly interactive and visually stimulating resources. The ability to access unbounded or dynamic information is what primarily distinguishes Web-based Instruction from instruction using interactive multimedia materials on bounded delivery vehicles such as CD-ROMs.

The CD has become a favoured platform in computer-based learning methodology. However, many digital forms or formats of representation such as frames, movies and floating notebooks can now be integrated with the Web. The distinction between these two delivery vehicles is blurring. Governments and other funding agencies will tend to support what they deem the most cost-effective. Costs for bounded media production are generally higher, due to labour and hardware requirements to produce and market a commercial product. A CD-ROM, once authored, is immutable but may offer high quality resources in a structured context. Web products can be altered instantaneously and can be used remotely and universally from home/office/classroom.

There is a number of important attributes of interactive multimedia, however it is delivered, that need to be discussed in order to focus upon the nature of the resources accessed by the learner.

Information representation

Information in a multimedia world can be presented in new and different ways. This may seem simplistic but it is an important consideration when designing or evaluating products and should not be overlooked. Imagine the student who sees a set of figures and cannot understand the underlying trend. A set of numbers which fluctuate with no obvious pattern may hide the fact that the underlying trend is upwards. Simply converting these numbers to a graph will reveal a new aspect of the information which is difficult to see otherwise. Similarly, viewing a map of the land or a spatial layout may actually provide an understanding of problems which are not evident in a straight text-based description of the issue.

Access-navigation

Creating access to information, especially using "hyper" links, can create new meanings not previously considered possible. Using interactive CD-ROM multimedia to model the knowledge base and to give the user freedom to interact with it, gives autonomy back to the user. Rather than provide a set of pre-designed sequences that assume one learning model, a more interactive approach can be developed by giving the user a bounded information landscape and the tools necessary to explore and investigate the information. Package designers have used a variety of techniques to help users around such bounded information packages.

The unbounded Web is a virtual universe expanding like that of the real world. No one can give a true audit of its guesstimated fifty million pages, claimed by some to double in number every six months. Its saving grace is that the existing nightmare of quickly finding the constituent research from within this mass is being mellowed by a friendly growth of increasingly more sophisticated search engines.

Interactivity and control

Clear information representation and access facilitate the user's ability to find and manipulate much of the available information. Many proponents of the use of interactive multimedia talk about the interactivity involved in the exciting dynamic programmes. However, this can sometimes be a trap. Allowing the user simply to choose between a set of options or turn pages of cute animations is not interactivity. Nor can it be claimed that it is user control. It is important that the user is required to think before a response is possible. Consider a typical arcade video game, only a few control buttons are provided but the user can make a character jump, flail his sword, etc. This means that the choice and its consequence are part of the interactivity and intrigue of the game. It is the "stuff" which creates high engagement. However, adventure games often proceed along a time and movement axis which allows the user very little control over the direction the adventure might take. While this may be appropriate for a game, this type of movement through a learning environment might be very constricting and frustrate rather than engage learners.

Used effectively, the technology can allow users to interact in ways that the designers of the system did not plan and well designed interactive multimedia materials make it unnecessary to structure materials in advance for the user. Effective student use of unstructured materials, however will depend on access, understanding and available tools. Flexible access to the information caters for a broad range of users. Clear understanding of the metaphors used to structure information permits the user to identify clearly the mental model of the information provider and thus glean deeper meaning from that structure. The use of cognitive tools such as word processors, spreadsheets and multimedia authoring systems permit the user to extract, create, organise and orchestrate information his own way when solving personally meaningful tasks.

Interactive Environments and Problem-Based Learning

By way of example, there is a number of instructional strategies which can be well supported through modern interactive learning environments. Whether it be through an individual problem presented on CD-ROM or Web based collaboration, there are many advocates for problem-based learning (PBL) as a framework for motivating learners and generating high quality learning outcomes. For instance, Engel wrote: "Problem-based learning is thus particularly suited to assist students towards mastery in a range of generalizable competencies and to support effective adult learning in the cognitive and affective aspects of a course in higher education." (Engel in Boud and Feletti, 1991, 29). This is quite a pivotal statement for our understanding and appreciation of how "learning" takes place and how problem-based learning as an instructional strategy can facilitate such learning. This statement is based on the premise that one learns more by actually doing something than by being told how to do it. As a pedagogical approach originally discussed in the mid 1950s, problem-based learning is based on the premise that students learn more effectively when they are presented with a problem to solve rather than just being given instruction. As Stepien and Gallagher (1993) state: "Problem-based learning turns instruction topsy-turvy. Students meet an 'ill-structured problem' before they receive any instruction." In this way, students themselves "identify, and search for, the knowledge that they need to obtain in order to approach the problem." This turns the normal approach to problem solving found in university and college programmes on its head.

Perhaps the most institutionalised form of problem-based learning is the model developed by Howard Barrows for use within medical curriculum. (Barrows and Tamblyn 1980, cited by Ross 1991, 34). Barrows defines PBL as "...the learning which results from the process of working towards the understanding of, or resolution of, a problem." The key stages of the Barrows model can be summarised as: Problem Analysis; Information Gathering; Synthesis; Abstraction; and Reflection. The five phases can be implemented in a variety of ways and over various lengths of time. Savery and Duffy (1995) state that in their own implementation of PBL one problem presented carries through for the whole semester. Boud and Feletti (1991, 21) claim: "Problem-based learning is an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning. However, there are many possible forms that a curriculum and process for teaching and learning might take and still be compatible with this definition." The four principles below indicate the support that proponents of this particular strategy for the principles espoused as suitable for modern technology-based learning environments:

1. Learning is an active and engaged process. "Learners are actively engaged in working at tasks and activities that are authentic to the environment in which they would be used." (Savery and Duffy, 1995, p37).
2. Learning is a process of constructing knowledge. "Constructivism assumes that 'knowledge' is not absolute but is 'constructed' by the learner... Thus, the opportunity to find knowledge for oneself, contrast one's understanding of that knowledge with others' understanding, and refine or restructure knowledge as more relevant experience is gained, ... seems to harness the reality of learning." Camp (1996).
3. Learners function at a metacognitive level. Learning is focused on thinking skills rather than working on the "right answer the teacher wants." Students generate their own strategies for defining the problem and working out a solution. "Reflection on recent experiences is an effective method of learning: wisdom through reflection." (Engel in Boud and Feletti ,1991, p 28).
4. Learning involves "social negotiation." Students are able to challenge their thoughts, beliefs, perceptions and existing knowledge by collaborating with other students thus assisting their cognitive development process. "Co-operation is fostered instead of competition with colleagues." (Engel in Boud and Feletti, 1991, p 27)

Computer-mediated communications (CMC) as a problem-based learning strategy

Technology-mediated learning can play an important role in the problem-solving process. Interestingly, literature about CMC implies that such a medium can facilitate the four principles stated above for problem-based learning. Some of the applicable CMC features include: development of a sense of community among participants; peer interaction and sharing of views; greater autonomy in learning, collaborating and exchanging ideas; new roles for teachers as facilitators; networks for students to socialise and exchange ideas; and authentic context for learning. "Reflection" and "self-direction" are also stated as positive features of CMC but these features are dependent on the participants. Chambers (1996) described a study conducted by Palmer which "delineated a number of perceived deficiencies of CMC as a means of interpersonal communication which limit the transmission of interpersonal and social information, including the restriction of 'social presence,' diminished social context cues...." This may be a short term view as he continues by stating: "However, pending widespread dissemination of synchronous broadband telecommunications educational technologies, for most learners, the limitations of CMC for interpersonal communications noted in the literature remain valid."

In a study by Agostinho, Hedberg and Lefoe (in press), each student was required to create a learning experience for the class employing various technologies. Students provided their fellow students with Web-based study guides and they had access to a range of collaborative tools: "Live Chat" was used synchronously (in "real-time") during class sessions; a Collaborative Work Tool enabled students to create "workspaces" which enabled them to share files, messages, URLs, etc..; and a threaded discussion forum to create "conferences" by which all messages within each conference are archived and "threaded."

In a technology-mediated learning environment "...instructors are asked to articulate more clearly their goals and methods to others in the development team, students are also asked to take more responsibility for their learning" (Berge 1995). The results of the Agostinho, Hedberg and Lefoe study definitely supported this contention. The complex interweaving of content and process in the study required the students to reflect on the outcomes and how they were achieved. In part several of their assessments provided further chance for reflection and showed that the experience was valued for many reasons and at many levels. As a vehicle for the professional preparation of managers of technology-based learning projects, students claimed they learned not only methods but experienced first hand what they might be "inflicting" upon others, if they fail to manage the processes effectively.

Two extracts from two different student reviews of the course provide insights about its impact.

> ...a valuable learning experience despite the technical glitches, periodic support problems and communication difficulties. We learned as much about implementation of technology-based learning through the failed attempts to innovate as we did through the more traditional presentations and reading.
>
> I feel that the subject went a good way to preparing me to implement projects using a variety of technology based learning. When the subject started, my concept of technology based learning was CBL packages. This has certainly changed. Where I could see no application of the Internet or email to our work, I now see a huge potential... I am also now aware of the issues that confront a person charged with the implementation of such a programme, the need to have the technology in place and working...

Supporting Learning With Cognitive Tools

To return to the opening idea about the use of alternative strategies for learning that a change in underpinning theory provides, instructors have traditionally presented a linear narrative sequence which revealed the underlying structure of their ideas, based largely upon their understanding of the concepts, and their perception of the learning environments they have generated. However, learning environments in classrooms are affected by the behaviour of teachers which are the outcomes of the beliefs and goals a teacher brings to the classroom (McRobbie and Tobin, 1995). So too do the beliefs of students result in a diverse set of perceptions of the classroom learning environment (Roth and Roychoudhury, 1992). Ritchie et al (1995) have found, in exploring the boundaries of learning environments in a science classroom, that individuals and groups experienced different learning environments and that the actions of students and their teacher could be explained in terms of their beliefs, roles, goals and behaviours in various activity settings.

Current interactive multimedia technologies can represent ideas in almost any mediated form and, provided we can generate a comprehensible metaphor for organising our functional options and the underlying knowledge structures, students can roam through the resources, creating their own meanings and understandings of the phenomena they encounter, i.e. creating their own form of the learning environment rather than one generated by their teacher or by the package designer. With graphical and visual display coupled with large databases of resources, it is possible to explore an information space in whatever sequence appeals as appropriate to the user or to the specific task. When raising the idea Florin (1990, 30) saw "information landscapes, ...as virtual towns, or intellectual amusement parks. The analogy is quite intriguing and helps us to visualise many abstract concepts within a single metaphor."

This form of representation of information supports students' learning processes advocated by researchers like Schank and Cleary (1995) who have argued strongly for the use of such technology to support students in following their own interests or questions. This rich context has the potential to allow the novice to work with authentic problems and practice.

However, within this context, designers of multimedia learning environments have tended to be narrow in their view of how users will interact with the rich array of multimedia resources once a challenge, in the form of a problem to solve, has been posed. Instructional designers have not often taken full advantage of the technology that is being used to present these powerful ideas. Once the material has been presented to user(s) and they have interacted in the ways envisaged by the instructional designer (and often in new ways not considered by the designer) users are left to ponder and present their conclusions using more routine presentation technologies, such as pen and paper. Increasingly, users have access to the same multimedia technology but have lacked access to the rich digital media resources embedded in the learning environment.

As new theoretical views of learning have developed, it has been recognised that learners act as active constructors of knowledge. Within this constructivist framework, which is concerned with the process of how we construct meanings of our world as well as with the results of the constructive process, cognitive tools can help learners organise, restructure and represent what they know. Jonassen and Reeves (1996) have summarised the foundations of cognitive tools research and have identified the following key principles in the context of multimedia design:

> Cognitive tools will have their greatest effectiveness when they are applied to constructivist learning environments.
>
> Cognitive tools empower learners to design their own representations of knowledge rather than absorbing knowledge representations preconceived by others.
>
> Ideally, tasks or problems for the application of cognitive tools should be situated in realistic contexts with results that are personally meaningful for learners. (p. 698)

Additionally, cognitive tools to support the user have been shown by Jonassen (1995) and others to enhance the learning process and to support the users' investigations. If students are truly to create their own meanings and understandings of the phenomena they encounter, designers need to not only incorporate user tools which will enable them to present their findings using the full array of resources contained in the packages but also to support their investigations with powerful cognitive tools.

The lack of powerful learning environments embedded in much of the interactive multimedia products currently available cannot be entirely attributed to the lack of understanding of the results of cognitive science research by developers. The challenge for researchers not only to conceptualise powerful learning environments but also to demonstrate that process so that developers of educational software produce products that support learning in the most effective ways rather than predetermine the learners' needs, interests and preferred learning styles. This use of information technology offers the opportunity to shift the learning to student driven and directed learning.

Cognitive scientists are attempting to narrow the gap between the learning environments portrayed in many commercial interactive multimedia packages and learning environments that will truly enhance learning. Schank and Cleary, 1995; Korcuska, 1996) have described a set of innovative learning architectures based on their conceptualisation of realistic learning situations. They have created powerful example implementations of cognitive tools where different cognitive learning strategies are built into software and the learner is encouraged to explore their ideas and solutions with differing degrees of support and advice.

The innovative use of cognitive tools in interactive multimedia learning environments has also been reported by Lajoie and Greer (1995). The package Bio-World is an interactive learning environment designed to support the acquisition of scientific reasoning skills in high school students and integrates a variety of cognitive tools to assist in scaffolding scientific reasoning activity. Users of this package are engaged in explicitly justifying hypotheses with evidence; organising, categorising and rating evidence; and constructing a final summary argument on the topic of bacterial and viral infections.

Exploring the Nardoo with student-driven investigations

With an understanding of the shortcomings of much of the commercially generated learning packages, the team at the Interactive Multimedia Learning Laboratory, at the University of Wollongong, have sought to combine the ideas of situated learning and problem based learning from rich information landscapes to form the basis for effective design. Within this context we also sought to incorporate a range of cognitive tools within the landscape which would contribute to supporting the learner. The detail of this design process and the theoretical position has been reported in Hedberg et. al. (1994). The resulting package, *Exploring the Nardoo*, provided a rich information landscape of resources based on ecology. The information landscape uses a geographic metaphor based upon a Water Research Centre and a navigable river environment. It incorporates problems that challenge students to become active participants in the learning process and simulators that allow the user to ask questions and investigate possible answers to those questions. By providing a metaphor relating to the real world, students are encouraged to apply scientific concepts and techniques in new and relevant situations in this ecology-based application throughout the problem-solving process. In so doing, the learner is likely to become more interested in developing questions, ideas and hypotheses about the learning experiences encountered. As an alternative teaching/learning strategy in the development of inquiry and problem solving techniques, this package incorporates high quality visual materials in the form of graphics, sound, text and motion video together with scientific measuring tools to aid in the construction of understanding.

Exploring the Nardoo **provides the student with a flexible set of tools made available through a personal digital assistant (PDA), Figure 2, to assist in the investigation** process.

TOOLS
VIEWER
NOTES
Phosphorus -μg/L
Temperature -°C
Turbidity -NTU
Algal Cell Count -c/mL

Figure 5: The Personal Digital Assistant notebook

The process of using source material within the package in support of an investigation has been enhanced to allow the student to:

- Decide precisely on the quantity and selection of text to be copied into their notes. This is either through making a selection and then 'grabbing' it into the PDA or by using a 'drag and drop' technique where the target text is selected or highlighted and 'dragged' into the notes module of the PDA .
- Use marker buttons as pointers to video, audio or picture information which can be displayed within the PDA's viewer along with any linked information. User defined portions of the reference text material displayed within the viewer may be selected and copied into the notes also.

- Manipulate marker buttons and text within the notes areas, via 'drag and drop,' to facilitate the re-ordering of ideas in the process of building an investigative response in the form of a report, explanation, procedure etc.
- Use text style tools, within editable text notes, providing the opportunity to use font colour, style and size as organising criteria within the notes.

The joint combination of note book and viewer equips students to view and then critically to evaluate or compare different representations of the same information concept. By collecting different media representations of the same topic and 'flipping' between these representations at their discretion, the student has the opportunity to establish cognitive links between different media forms which complement each other and support a central theme or information focus.

The package also provides the ability to record thoughts and impressions 'on-the-fly' whilst examining media stories. This provides the potential for students to reorganise or revise their thoughts to better 'make sense' of what they see and hear. Students are able to document their emerging ideas in support of an investigation or problem solving exercise whilst viewing different media. This provides support in the formulation of new schemata in the process of accommodating the new information.

Successful problem solving activities are reliant on numerous individual, social and environmental factors. From a technique perspective, *Exploring the Nardoo* endeavours to assist students by providing some structures, or templates, upon which they can build their note taking or response writing activities. These are in the form of writing genre templates. Students may access the book containing these templates (as well as other organisational help on note taking, presenting and filing) from within the Water Research Centre—a metaphor within the information landscape of the package. Genre descriptions can be viewed and a genre template can be copied into the notes and used as a scaffold upon which to build or fill-in relevant information found whilst exploring the package.

To facilitate the re-ordering or re-prioritising of information *Exploring the Nardoo* provides a separate, expanded form of the notebook. This device has been termed a 'text tablet.' It provides the editing facilities offered by the PDA as well as other features to assist with the restructuring of notes into a form more suited to small group presentation or a particular genre style. The text tablet provides a larger expanse of editable screen/document space into which student notes may be copied to/from the PDA notes module.

A writing genre template can also be loaded directly into the text tablet into which portions of the student's notes may be copied or dragged. Notes from prior sessions can be loaded into the text tablet and used in support of current investigations. Being able to store and report thoughts and impressions derived from media experiences by using the media itself (actual video/audio and pictures, not just text representations of the media) provides a more powerful means of 'reformulating' (Schroeder and Kenny, 1994, p965) ideas. We are aware however, as Schroeder and Kenny (1994) point out ,"learners not accustomed to this technique and multimedia facilities will require instruction in its use" before they become proficient with the technique but once accustomed to it the student has a powerful process at his disposal to gather, organise and illustrate his ideas. Support for teachers and students in the use of these features has been modelled using walk-through movies made available through the help system and also detailed in support notes available in reference books within the package.

The use of the notebook metaphor can be carried through to the creation of multimedia presentations. The notebook can be used as an organiser for drafting the presentation and should make the transition to a finished multimedia product seamless. Templates such as the genre templates within a notebook can be used as advanced organisers for the learner, especially those with little prior knowledge. The templates also provide a framework for gathering information and stimulating recall of prior knowledge.

By making such templates available and encouraging their use, we are assisting students through a modelled form of outlining. Identifying concepts within their notes that bear some relationship to part of a template structure requires high order thinking skills which "a) causes focusing on important points, b) helps students gain familiarity with text structure, c) aids retention, d) generates useful alternative texts to supplement materials read, and e) causes active participation in learning." (Bianco and McCormick, 1989, in Schroeder and Kenny, 1994, p966) The value of this modelling process is not faculty, learning style, level of school, or type of writing dependent.

The development by an individual of genre-specific schemata can have a number of generative and empowering consequences, the most significant of which is the development of the ability to communicate more effectively with a wider spectrum of the community by producing better responses to problems.

Conclusion

Learners using bounded or unbounded resources need to acquire a common set of skills in information appraisal, selection, organisation, structuring and communication of ideas in the solution of meaningful tasks. The nature (instructivist to constructivist) and source of these tasks (whether teacher or learner generated) help determine their relevance, complexity and ability to promote a deeper orientation to learning than simple rote learning.

Learners as knowledge constructors share some fundamental features, whether working individually or in groups, on traditional screen based structures or within more of a Web page hypertext architecture. They develop diverse skills in data/media selection, generation, organisation, orchestration and re-structuring. The opportunity to share the results of construction labour with others permits these active learners to gain feedback as to whether their level of understanding is sufficient to facilitate meaningful communication of ideas to others. The means of information representation is as unique as the individual or group. Interactivity resides in both the recursive construction process and within interpersonal communications. It no longer relates to the ability of a user to manipulate data within a fixed structure. The ultimate in interactivity and motivation is the process of personal knowledge construction. The additional skills demanded of the learner as producer deal with resource management and increased metacognitive awareness of what is largely a self-regulated process.

It is expected that the current seemingly different worlds of learning technologies will increasingly coalesce and the differences will largely be determined by the cost of access rather than the technology's physical form. The fundamental difference between the bounded and unbounded resource banks resides in the essential nature of learning activities. The design of interactive multimedia learning environments will increasingly include authentic activities which can be understood by less dextrous learners with specific cognitive tools, and different forms of representation. The significance of change facilitated by Web developments is the move to the Virtual Classroom. The challenge for educators is to devise better cognitive tools to support the process of learning and to facilitate the growing awareness of how they as learners understand their own approaches to a world of complex problems and expanding information provision.

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Capitalising on Interactive Multimedia Technologies in Dynamic Environments

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1.0 Introduction

It is widely held that creativity, flexibility and breadth of knowledge will be among the most important attributes of successful managers and operations staff in the years ahead [1]. The downsizing of the workforce and restructuring of the workplace in the 1980s and '90s has given credence to such projections and, at the same time, turned attention to new expectations for education and training—for heightened problem solving and critical thinking abilities. There are well-supported indications that many workforce transformations will take place globally [6].

These changes in both the workforce and the workplace are triggering new expectations for the education and training of current and future workers. Organisation members are expected to be able to deal with the dynamics of change and have greater problem solving capabilities. They must be able to create and use knowledge effectively, interconnect concepts and make semantic links between components of information and solve problems.

Multimedia technologies[1] are having a dramatic effect on both the process and product of learning. It is increasingly evident that multimedia can enhance an individual's problem solving skills. The active mental process of imaging, a key element in multimedia presentations, is important for recall and retention. Multimedia also makes it possible to combine interview and dialogue with visuals, animation and textual information [4].

This paper describes the ways in which educators and trainers can capitalise on multimedia technologies to create alternative learning environments.[24] The next section examines the ways in which a sample of global firms has shifted its training initiatives to the use of advanced interactive audio/visual/animation platforms, and the results the firms have achieved. The final section raises challenges to be considered when evaluating the potential of multimedia technologies in dynamic learning environments.

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[24] "Learning environment" is used in this discussion to mean both business and government training settings as well as the traditional college, university and secondary education classroom and laboratory.

2.0Growing Knowledge Requirements

Greater challenges in the environments of business and government in turn mean changes for education and training. It appears that the need for more dynamic learning environments and the necessity to have a means for assisting individuals to develop their critical thinking capabilities can be fulfilled through the leveraging of multimedia technologies.

2.1 A Dynamic Learning Environment

It is well understood that, whether in the classroom or on the job, most people learn best by exploration. Such learning begins when infants learn to navigate, first going from object to object in the home. Gradually they extend their evolutionary process beyond the boundaries of their comfort zone. For children, information sharing often *follows* exploration.

It may be argued that the predominant mode of learning for *everyone* is by navigating through an endless series of encounters. As we navigate from one event to the next, we absorb an enormous amount of knowledge—not only information—about our physical and mental world.

Unfortunately, most formal learning environments (e.g., university classrooms and corporate training centres) do not capitalise on learning by exploration. Rather, they feature linear learning programmes where the dominant influence is typically the facilitator's structured plan for the session.

2.2 Stimulating Critical Thinking Capabilities

Linear learning methods seldom provide enough chance for critical thinking nor do they direct the individual's focus on problem solving processes. The importance of augmenting the critical thinking skills and problem solving capabilities of both graduate and undergraduate students has been emphasised repeatedly as an essential skill to be developed and nurtured through education [3]. Similar needs have emerged in many business settings, a direct result of the growing number of initiatives aimed at employee empowerment. In spite of the attention directed to these needs, the fact remains that progress has been limited. Even so, there appears to be no end to the need for efforts aimed at improving the individuals' skills in these areas.

2.3 Leveraging Information Technology's Power

Information technology's (IT) evolution has progressed functionally and economically to the point where it can be a powerful tool for integrating the dynamic and exploratory learning described above into the traditional learning facility. It appears that IT can be deployed in a manner that leads to greater effectiveness in the use of knowledge for *problem solving*. In so doing, it can stimulate the necessary interconnection of concepts and creation of semantic links between knowledge components, and, in turn, new levels of achievement for both participant and instructor.

Among the principal IT innovations that form a basis for improving learning are multimedia and hypermedia. *Multimedia systems* provide the capability to take advantage of many human senses (excluding the sense of smell). Designed properly, multimodal interfaces capitalise on, even exploit,

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touch, hearing and sight, while multimedia content taps the feelings and emotions of users and recipients.

Hypermedia systems provide a means of dynamically exploring information, whether traditional text or more complex multimedia forms. A variety of paths through the information can be built into a tutorial, training, or presentation system, wherein the individuals using the system at a particular time and the situation in which they are involved determine the actual path [2].

In short, multimedia seeks to take advantage of the human senses. Hypermedia facilitates response to situations in which a user's information needs can be only partially anticipated.

Unfortunately, most automated learning systems have not been designed to capitalise on information technology in a way that markedly advances the learning process. Although desktop presentation tools have improved the appearance of visuals, the content itself has not benefited substantially. Outlines and numbered lists remain the principal content of visual supplements. Change in *appearance* is not the same as change in *form*. Meanwhile, the potential of multimedia technology and hypertext continue to go untapped in all but a few leading-edge settings.

3.0Emergent Principles for Multimedia Learning Systems

After examining a wide range of multimedia learning systems in business [7], a set of principles have emerged that suggest how dynamic learning environments can be developed. Eight principles are discussed in this section (Table 1)

• Capitalise on the powers of illustration
• Pull information into the learning process
• Engage the learner actively
• Use dynamic learning practices
• Emphasize a process of diagnosis
• Foster case-based learning
• Stimulate problem recall
• Provide a productive way to fail

Table 1

Principles For Multimedia Learning Systems

3.1 Capitalise On The Powers of Illustration

The age-old adage that a picture is worth a thousand words has never been more evident than when applied in multimedia-based learning systems, particularly in contrast to descriptive information. Most education and training environments rely on narrative presentations in which facts, principles and experiences are described verbally or in print. For many people, the exchange of such descriptive information is synonymous with organized, formal learning settings.

Descriptive information only informs if the intended recipient is tuned into the message, ready to receive and process its contents. The number of persons in learning situations for whom descriptive information does not fit their natural learning mechanism is significant. Backgrounds, personal interests, listening and verbal skills, prior events and experience and current distractions all determine the extent to which reception occurs. Moreover, the characteristics of the presenter influence reception.

Multimedia technologies make it possible to design learning systems that are highly effective in illustrating, not just describing, concepts and practices. Any individual's senses of sight, sound and touch, as well as their feelings and emotions, can be brought to bear on the process.

An example will demonstrate the possibilities. Imagine the difficulty of describing a vision of change that will take shape gradually, over a period of time. Carefully worded descriptions could communicate some facts. But they might not convey the other elements of the vision as well as illustration.

This was the problem that the Atlanta Committee for the Olympic Games faced when it sought to tell the 86-member International Olympic Committee (IOC) about Atlanta's commitment to the Centennial Olympic Games. As part of its vision, it had to overcome the difficulty of describing, to a group of experts, the details of sports structures the city would construct over the next five years. Conveying the location of the venues and the arrangement of facilities within each structure was essential. Making IOC members aware of the proximity of one to another as well as means of access and egress was also necessary. Time and details are always the enemy of both the presenter and the recipient in these situations. Photographs, models and drawings are time-tested methods for meeting these challenges and are far superior to any narrative discourse. But careful use of multimedia heightens the power of illustration even more dramatically, as this example illustrates:

> The Atlanta Committee for the Olympic Games told its convincing story about the city's commitment to the Centennial Olympic Games through creative use of sight, sound, and animation. The International Olympic Organizing Committee was able to visit each venue for the games, even though some had not been constructed. Used for the first time ever in an Olympic presentation, a multimedia system, running on an ordinary desktop microcomputer, offered viewers the capability to fly over the city, seeing every building, road, and tree from several thousand feet. Rotating the trackball pointing device to the right turns the viewer's line of sight to the right. Rotate it further and the viewer sees the sights just passed.
>
> Filming the city from an aircraft occurred first to capture Atlanta from the air. Segments of video footage were edited to include the many different views of the city's downtown and midtown areas as well as villages and landmarks. Multimedia technology even created and presented the venues that had not yet been constructed. The drawings and models of architects were captured in computer storage and transformed into an animated form. Then they were superimposed in the areas of the city where they would be constructed. The city's Olympic appearance was real, all visible on a viewer-controlled fly-over.

> The visual fly-over was only the beginning. Viewers were also able to zoom in on a specific sporting venue to check out the exterior and surrounding areas of the site. A click of the button put the viewer inside the venue where he or she scans around the stadium, and then zooms in on a particular seat or visits a concession. The roar of the crowd and waving of national flags accompanies the running, jumping, diving, or swinging of the athletes, all on the desktop computer.

Never before in the history of the Olympic Games had a local organizing committee shared so much information with such impact. The committee illustrated its visions, commitment and capability to the IOC through the application of multimedia technology, the first time such presentation methods had ever been used in delivering an Olympic bid. It was instrumental in the IOC's decision to award the Centennial Games to Atlanta.

Whether the focus is the business of the Olympic Games or a formal learning environment, illustration via multimedia technology means it is possible to exchange greater volumes of information with more efficiency and effectiveness, compared to verbal or written presentations. Add multimedia's interactive capability and the possibilities multiply.

3.2 Pull Information Into The Learning Process

When course leaders and educators design learning situations, the tendency is first to decide what the recipient needs to know. Then a means is devised to transmit that knowledge. Such "push" strategies have been the norm for generations. The philosophy behind traditional "push" learning systems is straightforward. The instructor has knowledge that must be imparted to the student. Verbally the message to the learner is: "You're going to need to know this, so learn it now. Then you need to remember it. Sooner or later it will be useful."

In contrast, learning systems designed using a "pull" strategy take a decidedly opposite view: Individuals should know the important foundation information, the fundamentals and the base-level facts. When facing a situation where additional information and guidance is needed, they should be able to draw on their knowledge sources to "pull" relevant information into use.

The philosophy underlying a "pull" strategy for learning is similar to that behind the construction and use of shared libraries. It is thought to be impossible for any one to keep on hand the full extent of knowledge that will be needed at any given moment. In contrast, if properly organized in a library or similar repository, a wealth of information can be made accessible to people when they need it. When such repositories are created, the problem solving emphasis shifts away from what an individual must remember to: (1) What are the right questions to ask? and (2) Where can information that will help build the needed knowledge to address the matter at hand be obtained?

Multimedia technology is stimulating a new level of awareness for this principle in business and government. For example, an international consultancy uses multimedia and a "pull" strategy in supporting learning to provide ongoing training and knowledge resources to its consultants around the world. Each individual carries a laptop computer with a CD-ROM player, sound board, high resolution video, communications capabilities, and a browser to access the Internet's World Wide Web (WWW).

Consultants maintain databases on their laptop computer containing information related to specific areas of the practice and knowledge about industries in which they work. Updates to the databases can also be downloaded from the WWW as needed. Each of the databases contains information provided by "subject matter experts," as well as forms, process models, diagrams and key questions, all aimed at aiding a consultant to serve the client. When the need arises, even during meetings, the consultant can retrieve factual, procedural and experience information for display on the laptop computer. In addition to descriptive information, illustrations, including animations and video clips, are only a mouse click away. The consultant must know the questions and the information sources that are available.

It seems that in these situations, just having bright people is no longer enough for the firm. It must also ensure that consultants have the resources to assemble critical information when the need arises. Hence, it is likely that "pull" strategies in learning systems, so engaging to people wrestling with a problem, will continue to evolve.

3.3 Engage The Learner Actively

When people are engaged they learn. Multimedia technologies can be deployed in ways that draw individuals into a learning process as active participants. In contrast to passive learning, where individuals are viewed only as targets or recipients, active learning systems make them "drivers." They influence, control and carry out activities that give them the desired insight and experience. (On the other hand, merely pushing a key to change a display, entering Yes/No responses to prompted questions or clicking a mouse to reveal new questions is not active learning.)

An international lodging chain developed an active learning system, using multimedia technology, to train front desk staff, back office personnel, housekeepers and property managers throughout its international network of hotels. The system was designed with several objectives: provide consistency of employee training; accommodate the diversity of language, skills and cultures in the workforce at individual properties and throughout the chain; provide maximum flexibility in training; and actively engage learners in a way that draws on their knowledge base, learning style, ability and experience even as it adds to their accumulation of experience.

The multimedia learning system lets managers and staff have control over access to the instructional content. They can freely move from topic to topic, merely by clicking on an easy-to-understand icon. Moreover, they can choose the area on which they seek to focus. For instance, front desk personnel can explore ways to handle various guest complaints and problems. Or they can use the system to practice different checkout procedures, depending on the nature of the group or terms of their lodging agreement. If they are unsure of a certain procedure, they instruct the system to walk them through a comparable but different, situation.

Learning is active. Each person can decide when to ask the guest (who appears on a computer-based video) a question, invoke a video response, have the response repeated, or view a video clip illustrating the entire checkout process. Or they can decide to review online procedures or request a video explanation from an online trainer.

The combination of active learning and multimedia has resulted in dramatic improvements for the lodging chain and its employees. Retention rates have leaped even as the cost of training (after construction of the multimedia system) has dropped to a fraction of its pre-multimedia cost. Hotel employees willingly spend more time learning, thus gaining a fuller understanding of the ins and outs of their responsibilities. Since the multimedia system resides on a desktop computer, never more than a few steps away, anyone can review an operational topic whenever he or she recognizes the need to do so.

3.4 Use Dynamic Learning Practices

The lodging example illustrates another important principle: Individuals benefit most when learning is dynamic. Linear sequences in which everyone proceeds stepwise along a single predetermined path *may* be useful in the *early stages* of a learning process, for they ensure that individuals first master certain foundation concepts and rules. Overall, however, it appears the path of learning should be dynamic, with branches along the path determined either by individual choice or by the individual's preceding actions.

Simple logic suggests this. Since a topic that is readily grasped by one individual may pose exceptional difficulties for another, the learning process that each follows should vary. Similarly, when learners are not fully confident in a specific area, they should have the option of spending more time on difficult issues. Rather than repeating the same learning, they should be able to readdress the concept while exploring different situations. (This is much like the child who masters the navigation of one object and moves on to the next.)

The lodging chain's interactive system makes this is possible by providing a wide array of situations and information resources. All are online and available for the use anytime.

3.5 Emphasize A Process of Diagnosis

The best learning in business or on campus is: (1) problem focused and (2) aimed at applying concepts, techniques and information to address the problem. Here emphasis is placed on *effectiveness* of learning, not its *efficiency*. Rote learning may appear faster and more efficient than learning by diagnosis or problem solving. However, under close scrutiny, its long-term effectiveness is often limited.

When people struggle to identify a problem (or opportunity) they must mine both the breadth and depth of their knowledge. They observe facts and compare them with closely held knowledge. Likewise, they must evaluate problem characteristics. Some alternative tactics and solutions are immediately ruled in or ruled out. Depending on the situation, they may decide that tests are needed to determine the usefulness of other courses of action. However, in order to do any of the above, one must either have or know of essential information in their knowledge base, or realize that it is absent. If it is absent, guided learning and debriefing protocols should point out details or alternatives that were overlooked.

Multimedia-assisted diagnostic learning is particularly effective when applied in fields where personal knowledge depends on accumulated experience:

> The medical student is confronted by an elderly patient complaining of shortness of breath. The student can listen to a computerized stethoscope and hear the heart murmur that indicates aortic stenosis, a partial blockage of the aorta. (This is valuable learning since often no actual patient with aortic stenosis may be on the ward at the time the topic is discussed in class.) Then, by pressing a key, the student can compare the pathological murmur to the sound of a normal heartbeat.
>
> Perhaps the students hear a snap sound in the second part of the heartbeat. 'What disease might cause that?' the student ponders. On request, the computer brings up a list to consider. Using the hypothetical diagnosis of aortic stenosis, the student can then ask what other findings one might expect and order tests, such as an X-ray, which shows that the patient has a large ventricle. The student zooms in on the picture to examine calcification of the aortic value. The system retrieves and displays in another window the medical textbook discussion of the diagnosis in question, including characteristic symptoms and possible treatments of the disease.
>
> Then the student requests a cardiac angiogram and a motion video sequence shows the heart beating as iodine contrast dye flows through it. The results of any test can be explored aurally or visually. Furthermore, the individual must first post a diagnostic hypothesis before the system will allow the test to be performed [5].

3.6 Foster Case-based Learning

Isolated facts are nearly always more difficult to remember. A setting that serves as a framework for weaving facts, assumptions, questions, principles, practices, techniques and outcomes into a comprehensive and cohesive picture is much more useful. Each setting, together with pertinent information, is a *case*. Diagnostic learning is best applied in case-based learning.

Some fields, such as medicine, are heavily dependent on experiential case-based learning. For example, a medical residency programme is conducted to provide experience and to enable physicians to create their personal base of cases on which they can draw in in practice.

Multimedia technologies are valuable tools for stimulating case-based learning. Rich case details can be captured and stored, the words and actions of people and the buildings and terrain of the surrounding environment. Actual field settings can in turn be recreated for presentation to learners who form diagnoses, determine strategies and take actions. For individuals working with cases while online, the impact is immediate. If intelligence is embedded in the learning support system, it can sense the facets of a case that are difficult for a particular individual. Then the system can present other versions of related cases for diagnosis.

3.7 Stimulate Problem Recall

The most effective learning occurs when individuals pose questions, aided by recall of prior experiences. This is why case-based learning (which supports the principle of recall) is a key element of problem-solving and critical thinking. The reconstruction of cases, reevaluation of their distinguishing characteristics and reassessment of outcomes, are all part of the process that ultimately leads to a diagnosis followed by development of an action strategy.

The power of recall depends on prior experiences. An awareness of new facts and the incorporation of additional information is also essential. The medical learning system is a useful exemplar of a design that supports both recall and use of new information.

3.8 Provide A Productive Way To Fail

Each of the preceding corporate examples illustrates a way to leverage the power of multimedia technology to engage the learner whereby they diagnose problems, apply knowledge and formulate action strategies. The illustrations also demonstrate another subtler but equally significant attribute: the freedom to make mistakes without consequences. This induces further learning.

Making mistakes is a part of learning. Parents expect that when they witness their toddler first learning to walk. Embedding multimedia's interactive features in learning systems provides the opportunity for individuals to take control, make mistakes and learn from the consequences of their actions. Yet they are shielded from serious consequences even as the process stimulates their personal growth and awareness.

Consider this process by which manufacturing and design engineers of an international company learn to avoid costly mistakes in product structure and material usage in the learning laboratory, not on the manufacturing floor:

> Working online, engineers begin by building a product that appears on their display screen, piece by piece, as they electronically drag and drop components into place. Since a cost is assigned to each piece and each connection, they are encouraged to meet the design and maintenance requirements with an assembly that not only fulfills requirements and quality levels but also keeps costs at a desirable level. The system displays accumulated costs in a visual counter that is incremented each time the engineer links pieces.
>
> If a mistake is made, no materials are wasted nor is credibility lost. Learning occurs rapidly since the employee can change the design and make the modifications through the system and immediately view the impact of the change.
>
> The company has found that employees completing the course develop better quality levels in the product they develop. They also meet more exacting product and marketing specifications, all at a lower cost than their counterparts who have not participated in the hands-on learning process.

4.0Discussion

The principles that emerged through the examination of learning systems in business suggest that multimedia technology can facilitate the exciting advances that are essential to individual success in dynamic environments. As such, they merit additional investigation to evaluate their promise further.

However, it is also likely that, like so many other areas of information technology, organisations developing multimedia applications in support of learning will have their share of disappointments, often through overselling of its capabilities by enthusiasts. Success and failure will largely be determined by selecting the most meaningful learning applications and implementing them in an appropriate fashion.

That said, the experiences of organisations to date suggest three dangers to avoid in dealing with multimedia:

1. Ignoring multimedia developments—There may be a tendency to view this as just another IT fad. Yet all indications are that the combination of audio, video, text, data and animation capabilities, coupled with interactivity and processing intelligence, can be a powerful force in organisation and individual learning. Those organisations with the vision and the commitment have the opportunity to alter not just learning but elements of both the workforce and workplace.
2. Seeking to force a standard too quickly—Some organisations recognize the promise of multimedia systems but they want to adopt the 'right' technology while avoiding the apparent hassle of different, often incompatible solutions. Hence they seek to adopt a preferred solution—a standard—as quickly as possible. After all, standards ensure manageability, or so the logic goes.
3. It is essential to recognise that there is no substitute for climbing the learning curve associated with multimedia learning systems (or any other technology). False starts will occur and disappointments will be encountered. They are all part of learning and are the very reason why seeking manageability before accumulating experience will mean missed opportunity.
4. Waiting to see—The easiest strategy is to wait and see; to watch while others develop new learning systems and create intelligent support systems that have a high impact on performance. 'Wait and see' will have a great deal of appeal in some organisations. It also has a great deal of risk if events are happening so fast that it is impossible for the late adopters to catch up.

Multimedia is a technology whose time has arrived. It merits careful consideration with an eye toward its possible role in unlocking the capability of the people in an organisation or in a learning system. But like information technology in general, the value of multimedia is not in the technology; it is in the learning innovations that it makes possible. And that comes from within.

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Multi-Media in Education and Training:

The meaning is the message

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I want to thank the organising committee for inviting me to this outstanding conference and for giving me an opportunity to share some of my ideas on the use of multimedia in education.

I was so very impressed with the sincere interest, wise analysis and clear support that was given to the importance of using technology in support of teaching and learning by His Excellency in his address. I was pleased that he underscored the importance of those of us in higher education working closely with teachers in the schools in this emerging field. I was especially pleased to hear his strong support for research in this field.

Last year, Canada's SchoolNet Advisory Board supported a three day seminar for 30 distinguished Canadians to develop a Vision Statement of Learners in the 21st Century (see Appendix A). As you will note in that text, the information age brings with it many opportunities, however, those of us who care about the wise use of technology in support of teaching and learning must be aware of the following learner-related challenges, namely: the speed and quantity of information transmission, the need to make personal sense of this information, the need for appropriate curriculum design and instructional strategies to support learning and perhaps, most importantly, the need for sensible teacher and peer support in learning situations. I believe we are making considerable progress in our attempts to meet each of these challenges.

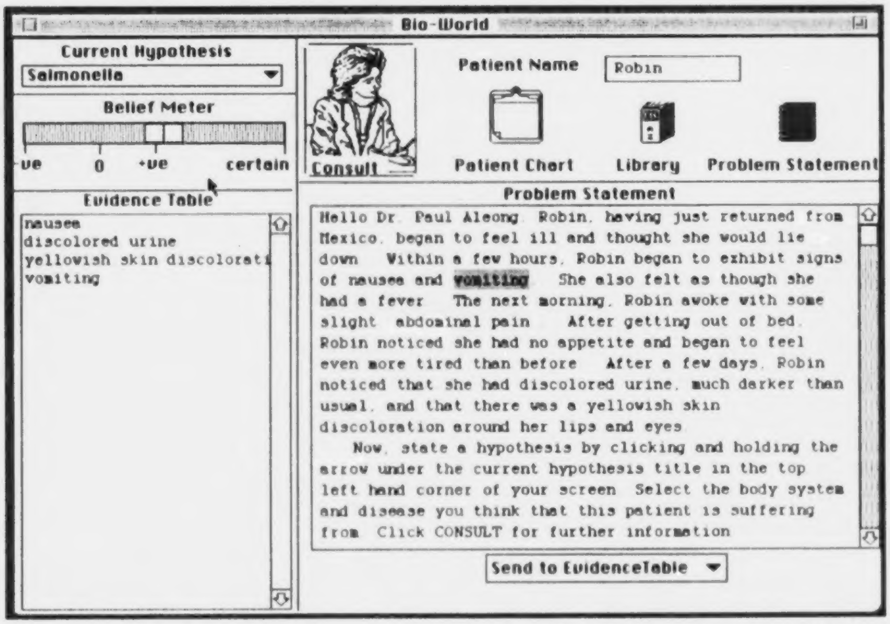
In the 1960s, Marshall McLuhan coined the well-known phrase "the medium is the message" to describe the nature of communication in the information age. I wish to contend that a paradigm shift is underway from the "medium is the message" to "the meaning is the message no matter what the medium". More than ever in our knowledge-based society, we must use learning technologies to enhance opportunities for interaction with the material to be learned in ways that facilitate the development of shared meaning no matter what the subject matter or learning environment. However, in doing so we must make use of the multiple inputs that are available to enhance meaningful learning. The following projects underway in my faculty at McGill University illustrate the benefits of the interactive effects of these different input sources on multi-media learning.

Bio-World

Allow me to share with you a number of McGill projects that are underway at this time that demonstrate some of the different ways my colleagues are trying to help learners construct greater meaning through multi-media supported learning. In doing so, I wish to draw attention to the variety of strategies that are being used to support meaningful learning. Dr. Suzanne Lajoie and her colleagues (Lajoie, Greer, Munsie, Wilkie, Guerrera and Aleong; 1995) have developed a software programme entitled Bio-World. Bio-World is an interactive computer-learning environment designed to support the acquisition of scientific reasoning skills in high school students. It integrates a variety of cognitive tools to assist in scaffolding scientific reasoning activity. Specifically, Bio-World provides a hospital simulation where students learn to reason about infection. It poses realistic diagnostic scenarios and encourages students to solve diagnostic problems by collecting different types of evidence to confirm or revise their hypotheses.

As Dr. Lajoie (1993) has observed, very often in classroom situations, students are taught declarative knowledge about bacterial and viral infections; however, Bio-World provides a mechanism for putting this declarative knowledge into practice by providing opportunities for students to use such conceptual knowledge in the context of realistic problem-solving tasks, such as diagnosing a disease. In doing so, the Bio-World programme provides a number of cognitive tools to help the students store, integrate, and analyze information on the patient's case history and test results.

Figure 1 illustrates the design of the programme. Note the patient's name, the problem statement as well as the evidence table on the left which helps the students record information on the case.



Current Hypothesis: Salmonella

Patient Name: Robin

Evidence Table
nausea
discolored urine
yellowish skin discolorati
vomiting

Problem Statement

Hello Dr. Paul Aleong. Robin, having just returned from Mexico, began to feel ill and thought she would lie down. Within a few hours, Robin began to exhibit signs of nausea and vomiting. She also felt as though she had a fever. The next morning, Robin awoke with some slight abdominal pain. After getting out of bed, Robin noticed she had no appetite and began to feel even more tired than before. After a few days, Robin noticed that she had discolored urine, much darker than usual, and that there was a yellowish skin discoloration around her lips and eyes.

Now, state a hypothesis by clicking and holding the arrow under the current hypothesis title in the top left hand corner of your screen. Select the body system and disease you think that this patient is suffering from. Click CONSULT for further information.

Figure 1. Example of the key elements in the Bio-World interactive software programme.

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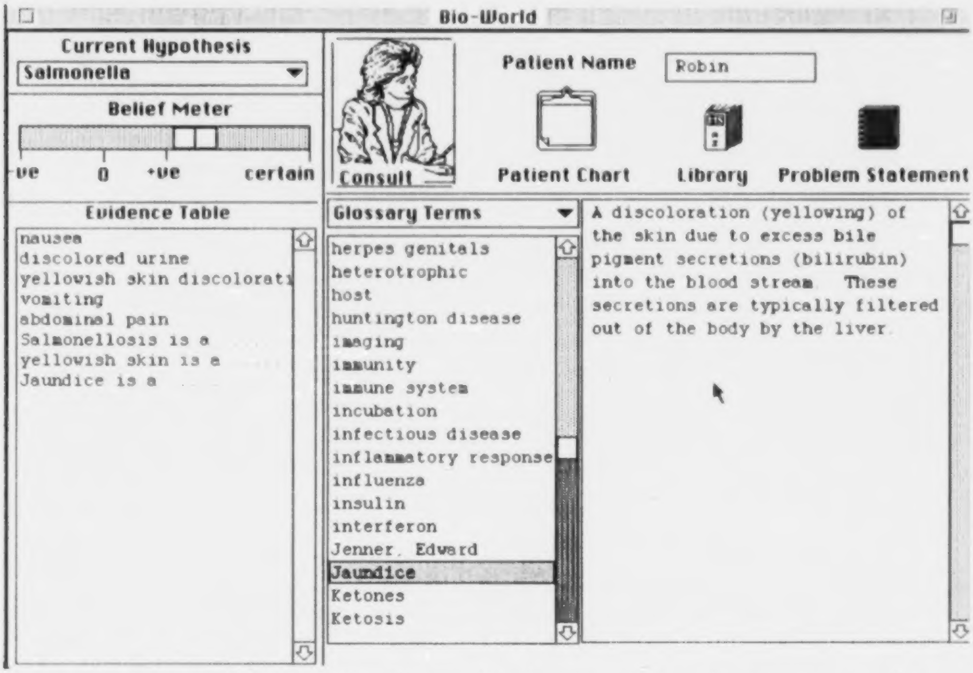
One can also note that the current hypothesis of the students is that the medical problem is salmonella poisoning as recorded in the top left corner. The belief meter indicates the degree of confidence that the students have that their hypothesis is the correct one. Note at this point, it is only at the "somewhat certain" level.

Figure 2 illustrates the use of the glossary of terms. The student has highlighted "Jaundice" and the right hand column provides a definition of this term.



Current Hypothesis: Salmonella

Patient Name: Robin

Evidence Table:

nausea
discolored urine
yellowish skin discolorati
vomiting
abdominal pain
Salmonellosis is a
yellowish skin is a
Jaundice is a

Glossary Terms:

herpes genitals
heterotrophic
host
huntington disease
imaging
immunity
immune system
incubation
infectious disease
inflammatory response
influenza
insulin
interferon
Jenner, Edward
Jaundice
Ketones
Ketosis

A discoloration (yellowing) of the skin due to excess bile pigment secretions (bilirubin) into the blood stream. These secretions are typically filtered out of the body by the liver.

Figure 2. Example of the Bio-World glossary tool and changes in the students confidence in the certainty of their current hypothesis as recorded on the BeliefMeter.

One can also note that the current hypothesis is still salmonella and the belief meter is only somewhat certain. In Figure 3, note that the current hypothesis of the students has changed to hepatitis A; however, an analysis of the vital signs and test results have led to an increased list of symptoms and information on the evidence table. At this point, the students are getting closer to a correct diagnosis and as we would expect the belief meter reflects their increased certainty.

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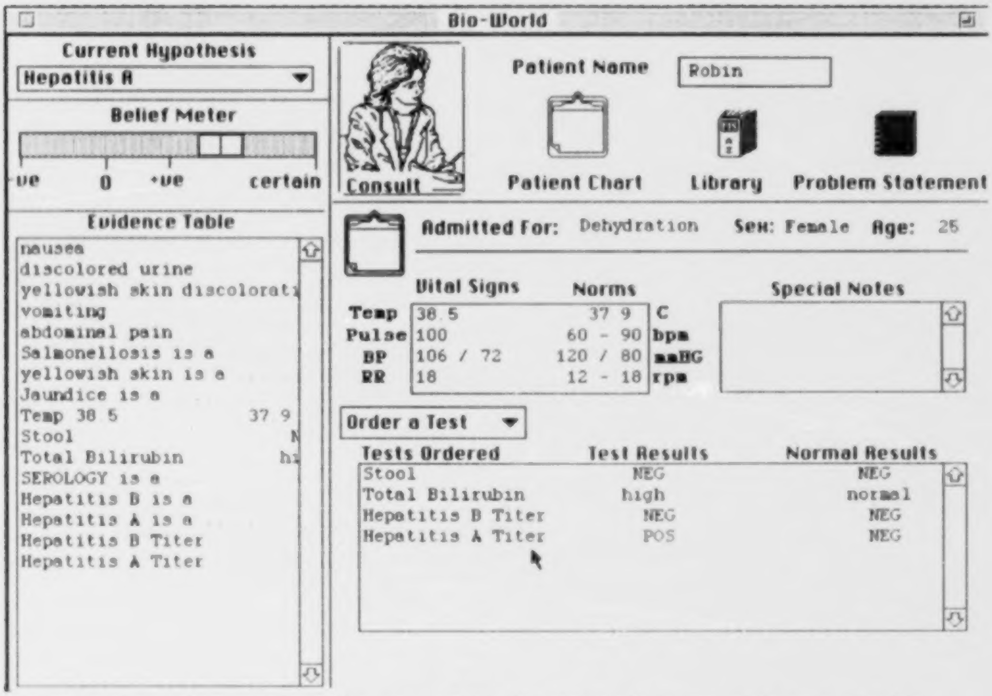

Current Hypothesis: Hepatitis A

Patient Name: Robin

Evidence Table

```
nausea
discolored urine
yellowish skin discolorati
vomiting
abdominal pain
Salmonellosis is a
yellowish skin is a
Jaundice is a
Temp 38 5                37 9
Stool                        N
Total Bilirubin             hi
SEROLOGY is a
Hepatitis B is a
Hepatitis A is a
Hepatitis B Titer
Hepatitis A Titer
```

Admitted For: Dehydration **Sex:** Female **Age:** 25

	Vital Signs	Norms	
Temp	38 5	37 9	C
Pulse	100	60 - 90	bpm
BP	106 / 72	120 / 80	mmHG
RR	18	12 - 18	rpm

Special Notes

Tests Ordered	Test Results	Normal Results
Stool	NEG	NEG
Total Bilirubin	high	normal
Hepatitis B Titer	NEG	NEG
Hepatitis A Titer	POS	NEG

Figure 3. Example of the use of Bio-World vital signs and test results influencing a change in the current hypothesis to hepatitis A.

In the video clip that was shown during this address, one could note that the students were working in groups of two on the Bio-World programme. One could hear their discussion, as they checked the symptoms of fever, abdominal pain and no appetite and discussed the next steps in the problem-solving process. The ongoing interaction between the students as well as their collaborative work with the Bio-World programme fosters the development of meaning in contrast to traditional video or audio presentations that simply present material to the students without the benefits of well-designed pedagogical and learning aids.

Before concluding our brief examination of the Bio-World programme a key question to ask about this interactive programme is what cognitive tools underlie its design? Dr. Lajoie reports that Bio-World was designed to provide support for memory and metacognition. Furthermore, it provides for safe scientific practice and utilizes adaptive feedback throughout the problem-solving process while allowing learners to generate and test multiple hypotheses in the context of problem-solving. It is an excellent example of the use of multi-media in support of meaningful learning.

Ados Branchés

Allow me to report on another multimedia project developed by Dr. Alain Breuleux and his colleagues at McGill. The title of this project is a play on words in French; *ados*, for adolescents, and *branchés*, for wired in, the result is *ados branchés* which in colloquial English might be labeled "plugged-in teens".

The video clip that was included in the presentation showed a class of French immersion students in a local secondary school in Montreal, Quebec, who were linked by the Internet to a similar class in Calgary, Alberta, over 2,000 miles

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away. The students were intensely involved in publishing their own electronic newspaper. The inter-provincial collaboration by the students and the active use of various multi-media tools enhanced their interest and commitment in the area of literacy and writing skills in a second language.

The *Ados Branchés* project is another example of the value of interaction among students on topics that are of interest to them. The comments made by the teacher as well as the interest and commitment of the students shown in the video clip clearly documented their appreciation of the project. It is especially good to note that this project was completed totally in the students' second language - French. Again, meaningful learning was enhanced through the wise use of electronic communication, sound classroom support by teachers and a well designed and motivating activity.

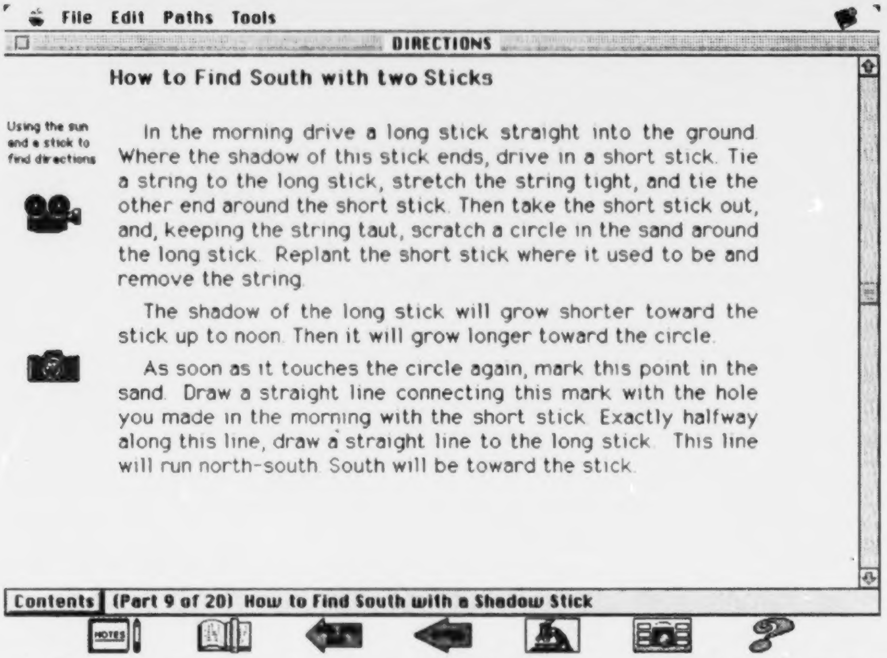
Integrated Science Education

Another multi-media project that my Quebec colleagues at McGill University and the Université de Montréal are working on with colleagues at the University of Alabama in the United States is entitled Integrated Science Education. Dr. Larry Rainey is the Director of the Integrated Science Education project at the University of Alabama and Dr. Kate Le Maistre is Director at McGill. This multi-media project uses field and studio produced video programmes of scientists and science educators, satellite television transmission of the programmes to many different schools by way of Tele-Quebec, inexpensive laboratory equipment and materials, a week-long teacher education programme each summer and, most importantly, ongoing support of teachers via the Internet throughout this year. During the presentation, the video clips demonstrated each of these aspects of the project.

The Integrated Science Education project is an excellent example of trying to ensure that the message students construct is a meaningful one. We know that meaning is developed and enhanced through ongoing interactive discussion - the Integrated Science Education project facilitates such interaction through cooperative learning amongst students as well as teachers. The enthusiasm of both students and teachers shown in the video clip strongly supported the value of this multi-media project in science education.

Multi-Media Learning

Before closing, I would like to share a research project designed to investigate the influence of various factors on the effects of multi-media on the learning of 12 year old children. My colleagues Drs. Large, Beheshiti, Renaud, and Breuleux have been involved in this project. This study investigates the effects of different combinations of media presentations on learning the concept and procedures to identify south by the use of the sun's rays. The children were divided into four different presentation groups, namely, text only, text plus animation, text plus captions plus animation and captions with animation. Shortly afterwards, the students were asked to recall what they had learned in their own words and also asked to enact how they would find south using a model to facilitate the enactment. Figure 4 presents the text on how to find south by using two sticks of different size. The text was taken from a Compton's Multimedia Encyclopedia using Apple Quick Time.


File Edit Paths Tools
DIRECTIONS
Using the sun and a stick to find directions
Contents
(Part 9 of 20) How to Find South with a Shadow Stick
NOTES

How to Find South with two Sticks

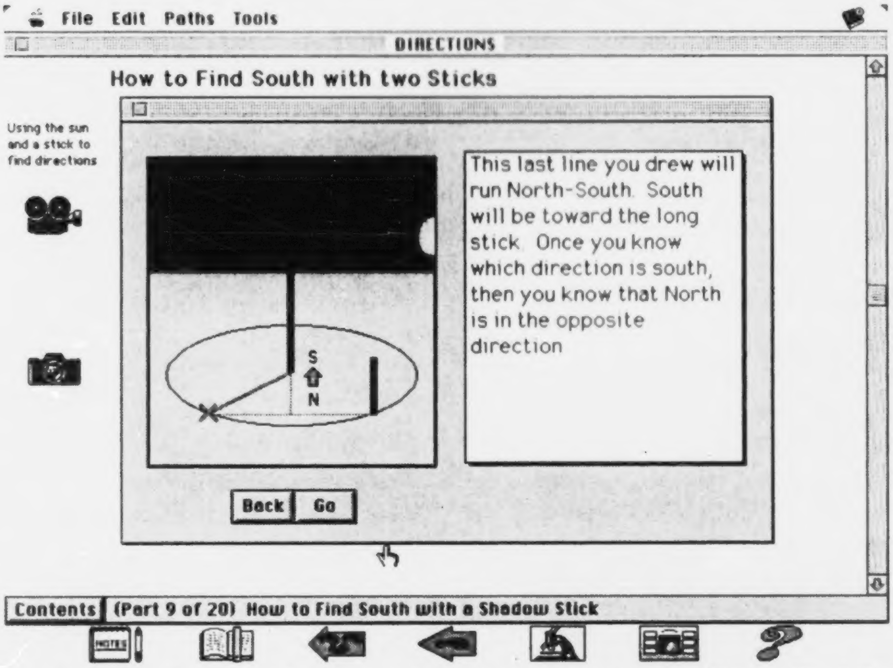
In the morning drive a long stick straight into the ground. Where the shadow of this stick ends, drive in a short stick. Tie a string to the long stick, stretch the string tight, and tie the other end around the short stick. Then take the short stick out, and, keeping the string taut, scratch a circle in the sand around the long stick. Replant the short stick where it used to be and remove the string.

The shadow of the long stick will grow shorter toward the stick up to noon. Then it will grow longer toward the circle.

As soon as it touches the circle again, mark this point in the sand. Draw a straight line connecting this mark with the hole you made in the morning with the short stick. Exactly halfway along this line, draw a straight line to the long stick. This line will run north-south. South will be toward the stick.

Figure 4. Example of text-based directions on "How to Find South With Two Sticks".

Figure 5 is an illustration of the same type of text with animation.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NOTES

How to Find South with two Sticks

This last line you drew will run North-South. South will be toward the long stick. Once you know which direction is south, then you know that North is in the opposite direction

Figure 5. Example of the use of text with animation on "How to Find South with Two Sticks".

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Figure 6 presents the results of the students on the recall and the procedural enactment of the task of finding south.

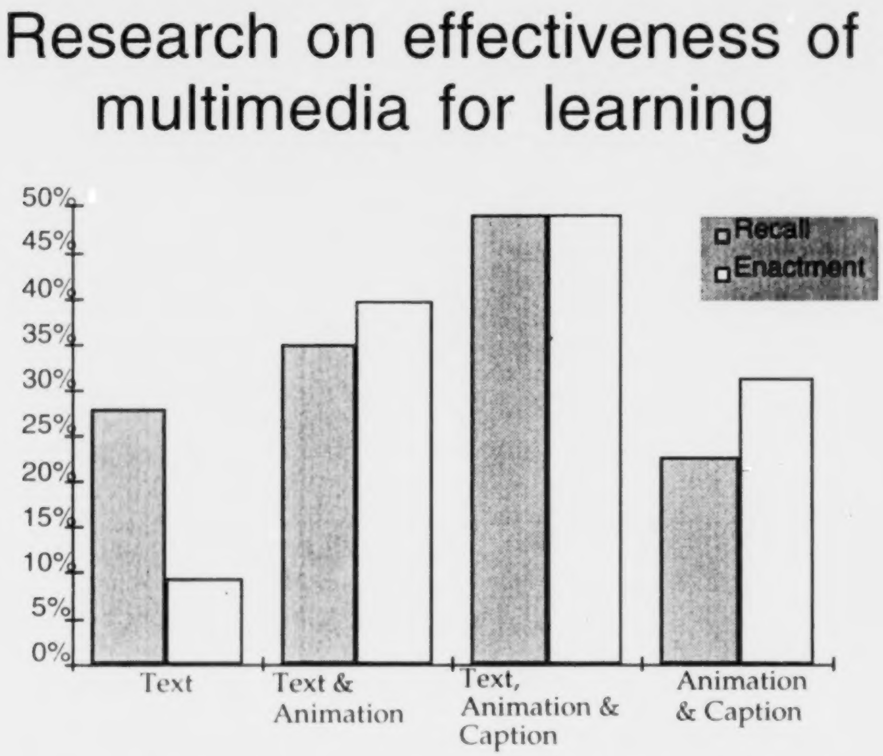
Research on effectiveness of multimedia for learning

Figure 6. Student results on the recall and the procedural enactment of the task of finding South under different multi-media learning conditions.

The clear implication of the results shown in Figure 6 is that the text with animation and captions improved both recall and enactment. Note especially the minimal effect of the text alone on procedural enactment scores which clearly shows the value of the animation sequences.

My colleagues at McGill have a number of other projects designed to investigate the impact of using different types of multi-media combinations to enhance meaningful learning. However, time constraints have limited the number that have been described here.

Lessons Learned

What lessons have been learned in the above programme development and collaborative research projects on the appropriate use of multi-media in education? Some of the most important ones are briefly described under the following key categories: the learner, the teacher, the structure and presentation of knowledge and the learning environment.

A. *Learners*

- The content and learning processes used must be suitably matched to the developmental level of the learner.

- Whenever possible the learner should have an opportunity to control and influence his or her rate of learning, such as the rate of information presentation, the kinds of information resources and the learner's production medium. Therefore, suitable strategies should be built into the learning process optimally to support learning.
- Formative evaluation strategies should be used throughout the learning process leading up to a summative evaluation of the products of learning.

B. Teachers

- Teachers should ensure that learners are appropriately supported throughout the learning process and they should proactively encourage learners to seek help in a systematic and informed way.
- Appropriate instructional strategies should be used to introduce and prepare students to control their own learning as much as possible. In doing so, learners should be encouraged, where appropriate, to work collaboratively with their peers.
- Through the use of appropriate prompts, teachers should help students develop executive strategies to control and evaluate their own learning in as much as learning how to learn should be one of the major outcomes of multimedia supported learning.
- Effective use of multimedia in the classroom by students depends on teachers' knowledge of learner-centred, project-based, technology-supported inquisitive learning. Therefore professional development of teachers is a crucial factor in the appropriate use of multi-media in the classroom.

C. Structure and Presentation of Knowledge

- Appropriate curriculum design principles should be employed to ensure that the structure and presentation of the knowledge to be learned is organised in such a way that students can construct their own knowledge in a meaningful and efficient manner.
- Differences in the structure and nature of knowledge should be recognised in the development of curriculum and instructional design packages. Special attention should be given to the differences in the processes of learning as they relate to declarative (conceptual) and procedural (process) knowledge.

D. LearningEnvironment

- The multi-media learning environment should be structured in such a way that students can work in groups and readily access teacher or peer assistance throughout the learning process.
- Care should be taken to ensure that the computer and other multi-media equipment used is configured to support learners of varying ages, sizes, cognitive and physical capabilities, as well as different learning styles and varying entry points.

Each of the above projects have utilized a variety of support strategies to enhance learning through the wise use of multi-media.

In conclusion, it is clear that through appropriate software, programme and curriculum design and development, the use of sound instructional strategies, the up-to-date education of preservice and practicing professionals and through collaborative research with those in the field, those of us interested in the wise use of learning technologies are attempting to ensure optimal learning while bringing meaning to the message. For it is through the development of a coherent and meaningful knowledge base that learners will acquire true understanding and ultimately active wisdom which is the central aim of our efforts in the field of education and training.

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ADDENDUM

VISION OF LEARNERS IN THE 21st CENTURY

Vision Statement

September 1996

Submitted to the

Training, Research and Evaluation Sub-committee

of

SchoolNet, Industry Canada
Government of Canada

VISION OF LEARNERS IN THE 21st CENTURY

Vision Statement

INTRODUCTION

Modern communication and information technologies are having an increasing impact on learning - how we learn, where we learn, when we learn, what we learn, what learning resources we have and why we learn.

It is important that our learning systems are guided by a vision of learners and of the communities to which the learners belong and which they are helping to create.

To open a discussion of these questions, SchoolNet held a workshop on April 19-21, 1996, at the CIBC Leadership Centre in King City, Ontario. There were over 30 participants from across Canada, coming from schools, governments, universities and a variety of organisations.

The purpose of the workshop was to develop a Vision Statement on learners in the 21st Century: what assumptions we should make about the characteristics and beliefs of a successful learner and a supportive learning system, the pressures and tensions involved in developing such a system, the core values that we should hold about learning, some of the possible directions we can follow, and some elements of a vision of learners, learning communities and the learning systems which would support them.

The purpose of this Vision Statement is to help SchoolNet build a vision of learners in the 21st Century and the kinds of learning systems needed to support learners and their communities. It is based on discussions in the workshop and on further development of the ideas by a working group.

The Statement is a work in progress, addressed to learners, educators, parents, policy makers, business and community leaders, politicians and all who are interested in the important subject of learners, learning, and learning communities.

This Vision Statement is intended to invite participation in building a vision of the learner the assumptions we are making, the core values guiding our vision and the elements of this vision. Participation is also invited on the problems and tensions we must address and the alternative directions we might take.

SOME ASSUMPTIONS ABOUT LEARNING IN THE 21ST CENTURY

These are some assumptions and beliefs about what learning may look like in Canada in the coming century:

Characteristics of the Learning Community

- Canadian society values learning and fosters and supports lifelong learning in schools, in the work place, in communities and in families.
- Knowledge and learning are major foundations of the social and economic well-being of Canada and Canadians. Knowledge and wisdom are among the major assets of both individuals and communities.
- A just and effective learning community must provide adequate resources for learning and an equitable system for allocating these resources.

Characteristics of the Learners

- The process of learning is innate and lifelong. Experiences in childhood and youth lay the foundation for lifelong learning.
- For people of all ages, young and old, learning is an integral part of playing and working.
- People of all ages have a capacity to learn and this capacity is affected by various social, economic and physical conditions and situations.
- People have a variety of learning needs related to their personal interests, their families, their communities and their work. These needs include personal development, social and civic responsibility, cultural enjoyment and continuing learning related to work and careers.
- People learn at different rates and in different styles, in different situations and at different times.

Characteristics of Learning Systems

- In a society undergoing significant and rapid changes, learning systems need to be accessible, flexible, responsive, diverse and balanced in their policies and approach.
- An effective learning system presents learners with a variety of patterns of (a) institutional affiliation, (b) service by teachers and resource persons and (c) access to technologies. These patterns vary according to the context, the kind of learning and the needs and style of the learner.
- Our learning structures and institutions - from preschool to university - are enhanced and extended by forming links and partnerships within the formal education community (e.g. with other schools) and with institutions, enterprises and associations outside the formal system (e.g. cultural institutions, media, business, community groups). The boundaries dividing school, work and community continue to dissolve and their activities mutually reinforce one another.
- Teachers will have new roles and responsibilities as institutional patterns and learning technologies evolve.
- Communications and information technologies are transformational technologies with powerful impacts on society and profound implications for learning and learning systems.
- An effective learning system enables (a) the participation of all sectors of society, including the private sector, (b) the wise management of resources, (c) the use of information technologies to amplify our efforts, (d) services which combine effectiveness and efficiency and (e) an appropriate investment of resources in all forms of learning.
- The quality of the our learning systems and processes is enriched and improved by using the knowledge and skills we gain by experience, innovation and research.

SOME CORE VALUES GUIDING OUR VISION

What values should guide our vision of the learner and the learning community?

Core Values of Learning Communities

- *The Goal.* Active wisdom as the goal of education, the application of knowledge, skills and attitudes for the benefit of society as well as the individual
- *The Social Project.* Collaboration of all aspects of society - political, economic, cultural - to enhance learning, make it our central social project and integrate it with life and meaningful work
- *Commitment.* A commitment by the community to provide adequate resources in order to sustain a learning society and the involvement of the entire learning community in the design of programmes, based on shared goals and a better understanding of one another's needs

Core Values of Learners

- *The Aim.* The development of active wisdom by acquiring a broad set of literacies, including language, mathematics, science, technology and culture
- *Responsibility.* The responsibility of learners for their own learning, their participation in learning activities, their exercise of choice, as well as their responsibility to apply their learning for the benefit of others
- *Values.* Recognition of the importance of values, attitudes, commitments, moral sensitivity and spirituality to the integral development of the person and the common good of society

Core Values of Learning Systems

- *Diversity.* Recognition of and support for the diversity of the learning needs of people, reflecting their origins, ethnic background, language, talents, social conditions and future aspirations
- *Special Needs.* Sensitivity to and support for the particular needs of certain groups such as Aboriginal people, recent immigrants, the poor, those who have suffered exclusion and discrimination, the gifted and those who live with special physical, social, psychological and learning challenges
- *Access and Equity.* Wide access to learning, equity of treatment and diversity of service for all learners, regardless of background, circumstances or special need
- *Wise Use of Technology.* Discerning use of technologies to enhance learning, in conjunction with teachers and institutions, and within a rich array of teaching/learning experiences
- *Quality.* Commitment to the highest quality of learning and service to learners
- *Research.* Priority to research in such fields as learning theory, effective teaching, information technologies, communication and many other areas, and to linking research findings to learning policy and practice
- *Teachers.* Recognition of the vital role of teachers in the learning system and their increased importance in developing and implementing new visions of the learning society
- *Diverse Careers.* Recognition that many learners pursue rewarding careers and vocations in trades, crafts and services that are not directly connected with high technology and advanced academic learning

INTERCONNECTED LEARNING COMMUNITIES

After reviewing a number of possible visions that are briefly described in Appendix B, consensus emerged on a vision of interconnected learning communities.

This vision is based on the principle that diverse learners need diverse learning systems.

Two educational metaphors are blended:

- the global learning *village* which fosters local community support, stimulation and collaboration, making use of institutions and teachers (both broadly defined) to provide identity and meaning, caring and belonging;
- the information highway which links learners and communities through affordable technologies with other learning villages and resources around the world, providing variety and scope, possibilities and choices.

Learning follows a developmental sequence from childhood through adulthood and maturity. We begin in families and communities where we learn our sense of personal identity, language and cultural heritage. As time goes on, we interact more and more with other learners in the community, in learning institutions and in other kinds of institutions. We make more use of technology and communication to expand our visions and range of knowledge.

As our learning and development increase, we learn to discern meaning from information and to expand our understanding of other communities in our country and around the world. We merge local and global approaches to learning and, with the guidance of teachers, we develop maps which help us maintain our roots and proceed on our journey.

If we visualize the *learning community* as one which:

- is compassionate
- values, fosters and supports learning
- provides adequate resources
- has shared goals
- includes all members of society

and if we visualize *learners* as persons who:

- should assume responsibility for learning
- live in a period of rapid change
- will be lifelong learners
- will have a variety of learning needs
- have needs different from other learners
- need a variety of experiences, services and structures
- should learn both alone and in common with others
- need a balance of learning experiences
- blend learning, working and playing;

then the *learning system* to support this learner should be:

- responsive
- adaptable
- respectful of diversity
- empowering
- accessible
- lifelong

- linked with community and reality
- affordable.

A new learning system for the future would involve changes in all the interconnected elements of the system: the framework of structures and funding; the processes of curriculum, instruction and assessment; the modes of access including institutions, teachers and technology and the rationale for the system based on research and evaluation. Many of these changes are now occurring in different places and in different ways. What they need is a guiding vision to shape them and to integrate them.

Framework

1. *Structures* are more varied with less emphasis on hierarchies and more on intersecting networks. Some networks are based on location (integrated school/community services), diversity of background (rural and urban schools, links among different kinds of communities) or community of interest (e.g. current centres of excellence).
2. *Governance* is based on the concept of the "learning community," participation of all members of the community in the decision-making processes. The role of political and professional leadership is to promote a common vision, guarantee respect for rights and quality of service and stimulate progress.
3. *Funding* is diversified but equity is protected by sharing resources among all members of the community. New approaches to funding and resource allocation need to be explored.

Processes

4. *Curriculum* is typically built around learning outcomes or common essential learning, clearly defined knowledge, skills and attitudes together with standards of expectation; basic education stresses multiple literacies, thinking, feeling, ethical behaviour, problem- based programmes, and applications of learning in work and life.
5. *Instructional design* links outcomes to assessment and stresses both individual learning (projects, independent study) and cooperative learning (peer teaching and collaboration); emphasis is on (a) constructing meaning, (b) skill mastery, and (c) interpersonal relationships.
6. *Assessment* includes evaluation of prior learning (e.g. pretests, challenge for credit, recognition of life experiences of adults) and alternative forms of assessment (e.g. portfolio, performance and authentic assessment).

Modes of Access

7. *Institutions* provide resources and services in a structured learning environment with an ethos supportive of learning individually and in groups; attendance involves different forms of contact but not necessarily full-time physical presence and learners may "attend" many institutions simultaneously. Schools, colleges and universities are linked with other formal learning institutions and with institutions outside the formal system (museums, libraries, science laboratories, business, and community centres). The effectiveness of institutions is defined in various ways, according to both the nature of their results (academic, personal) and the quality of their environment (security, resources, quality of teaching, student life, community links, etc.).
8. *Teachers* continue to be the main learning professionals, acting as guides, organisers, leaders, resources, programme designers and facilitators of learning - and as models of educated persons. Many teachers work in schools, while many others exercise their profession as independent

consultants, in government agencies, private enterprise or in community services. Some roles now filled by teachers are assumed by non-professionals and paraprofessionals. As teacher roles evolve, there are important implications for the definition of teacher, teacher education, professional development, working conditions and professional associations.

9. *Technology* dramatically expands access to learning, enriching the resources and expertise available to all learners and expanding services to those whose access to resources is restricted or who are not well served by present structures. "Distance" education, independent study and "following programmes" are alternative means of learning. Learning becomes separated from time (schedules, duration as a measure of achievement) and place (classrooms, schools and universities).

Rationale

10. *Research* provides the intellectual basis for learning systems; if our learning systems are the best we know how to design and our learning services are the best we know how to offer, then research must enlighten policy and practice and the links among research, policy and practice must be strengthened.
11. *Evaluation* provides feedback to learning systems, institutions, teachers and learners on whether we are learning the right things (as indicated by our state of knowledge in different fields), how well we are learning (in terms of efficiency and effectiveness) and the degree of match between learning services and learner needs. Current efforts to develop learning indicators are a step in this direction.

Almost all of these initiatives are occurring today. Many are moving us in the direction of a new vision of the learner and learning; some need rethinking and modification but still appear promising.

There are two important questions: How can a vision of the future of learning and the learner continue to be developed? How can these elements be integrated into a coherent yet open vision?

TAKING IT FROM HERE

A vision is a set of ideas, based on certain values, that requires leadership skills to develop, to win support and to implement.

Visions do not become realities unless someone gives them life. Any vision of the learner and the learning community - however clear, imaginative or attractive - will continue to be little more than a dream unless it finds sponsors with leadership and will, goals and resources, foresight and skill.

Working and thinking together, SchoolNet, educators, governments, business leaders and community groups are capable - with our *present* knowledge, resources and technology of providing all Canadians with a learning environment that is the best in the world, a defining feature of our society and a rich resource for all Canadians.

In the process of developing this vision statement, we have created a community, a family of educators, with a common concern and we have begun a process which will be ongoing and can be accessed through SchoolNet.

The work continues!

On behalf of the participants in the Workshop on Vision of the Learner in the 21st Century, held on April 19-21, 1996, at the CIBC Leadership Centre, King City, Ontario, sponsored by the Training, Research and Evaluation Sub-committee of SchoolNet,

N.B. Special thanks on behalf of SchoolNet to Hubert Saint-Onge and his colleagues at the CIBC Leadership Centre for facilitating the process and Norman Henchey for writing the drafts of this Vision Statement.

WORKING GROUP

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Appendix A: PROBLEMS AND TENSIONS

Our era requires substantial investment of society's resources in the learning community and profound changes in the role of learner and educator. As we move towards a new vision of learning communities and learners, we must acknowledge that certain problems, tensions and dilemmas will need to be addressed over the next few years. Among them:

- the complementary contributions of formal learning structures and informal approaches to learning
- the tension between the pressure of rapid change and the need for stability
- the importance of foresight and its difficulty in an age of unpredictability
- a desire to have a smooth transition to the future while recognising our assumptions about learning and learning systems are changing in profound ways
- the imperative of providing real, not just token, access to learning services to learners of all ages, in a climate of limited resources and increasing competitiveness
- the balance of the social-interdependent nature of learning with the focus on the needs and interests of the individual
- the tension between our social institutions founded during the industrial era and the new styles of learning emerging with information technologies
- how to ensure that the use of technology for learning enhances our opportunities and empowers us and does not dominate our lives
- the need to reconcile those who resist change in education, those who prefer moderate reform within existing assumptions and structures and those who see the need for profound change
- the balance between creative entrepreneurship and community responsibility, between private and public interest
- the tension between centralisation and decentralisation, standardisation and variety, public good and individual choice
- the tension between quality and standards on the one hand and equality and access on the other hand
- the balance between investing in education and investing in other public services and the balance in the allocation of resources within the broad field of education (early childhood, elementary-secondary, post-secondary, adult and continuing education)
- the tension between viewing the education enterprise as a short-term business and/or political opportunity or as a long-term strategic investment in people.

Appendix B: POSSIBILITIES

Learning and learning systems may move in a number of possible directions. The vision presented in this statement must be assessed in terms of some of the major alternatives:

Business as Usual

We continue going as we are, relying on our existing assumptions, structures and labour-intensive ways of teaching and learning. Attempts continue to integrate technology into existing structures. Resources are limited and in many places decline, affecting learning quality and public confidence. Competition among schools and school systems intensifies. Is this approach serving individuals and society well at the present time? Can we provide quality learning services with the resources available? Are we missing opportunities to make creative use of the new technologies?

The Funnel

The range of opportunities narrows as technology and global competitiveness limit the job market to low-level service skills needing little education and high-level technical and managerial skills based on post-secondary certification. For most of the population, a rewarding job is a scarce resource with few winners and many losers. What happens to the link between learning and career? What kind of learning is needed for those outside the job funnel? Can learning enlarge the funnel? Do we need new definitions of work and job?

Competing Systems

There is growing political conflict and economic competition for clients and funding, between the present education establishment and the virtual learning system of communications and information technologies in which teachers and institutions are of minor importance. Is such a conflict inevitable, built into the nature of competing philosophies? Would it be helpful or dangerous?

Appendix C: PARTICIPANTS IN THE WORKSHOP, APRIL 19-21, 1996

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Lisa McPhail, SchoolNet, Ottawa, Ontario
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Harvey Weir, Memorial University, St. John's, Newfoundland
Howard L. Yeager, University of Calgary, Calgary, Alberta

Maintaining Quality in Technological Education and Training

Baroness Perry of Southwork
President, Lucy Cavendish College
Cambridge University

Your Excellencies, Chairman, Ladies and Gentlemen:

I find it a very great honour to be with you at this very interesting and important conference and particularly as a representative of the United Kingdom, to celebrate what I think is a very long, historic friendship between our two countries. As the Chairman has said, I was privileged yesterday to visit his college, one of the colleges of the Higher Colleges of Technology, and I think we have much to learn from you. So if I come today to tell you something of recent British experience, it is in the spirit of sharing our experience and I hope to share yours in the coming months as well.

I congratulate the organisers of this conference on including the issue of quality of service because I believe that the future for all of us rests in getting it right in terms of education and training in a modern world for our young people and, indeed, for our existing work force.

We in the UK have had to tackle these issues rather sharply in the past 20 to 25 years in trying to learn how to educate our population in a way which fits the needs of a modern economy. If you would forgive me as an academic, I would like to begin very briefly with a little bit of history, and not because I'm here to teach you history, but because I think that if I explain to you where we come from in the UK, then it explains why we have introduced fairly draconian technology reforms in our education, in recent years.

Some of you may or may not know, that it is just over 55 years since we passed what was then known as a Great Education Act. It dominated the position of education in Britain for another 50 years or so and we got it hopelessly wrong. Perhaps if I tell you some of the blind alleys which we went through, that would help you understand why we're trying to get it right now. We assumed in that Education Act that we would have an unskilled work force of about 75% of the population, so we gave them what, in my rude moments, I call a kind of "*soup kitchen*" education. Something which was not actually leading them directly to important jobs, but which would affect them to work as good workers on assembly lines and in unskilled jobs. Only about 25% of the population at that time were seen to need the kind of technological and academic education which we now understand, of course, is the future for the global economy.

So the story of the past two decades has been trying to put right those mistakes, because those mistakes fed directly through into some of the economic difficulties which our country suffered in the 1970s. The lesson that we learnt is that no modern economy can succeed unless it begins (not follows), with the work force which is both adequately trained and adequately educated. The majority of new jobs that are now created in the majority of countries in the world are for highly skilled technicians and graduates, in a variety of fields. So, technological education is, as we have said so many times already in this conference, the key to economic competitiveness.

The second lesson we learnt is that economic planning must include appropriate educational planning. It's no good just planning the future of your economy, and I know that here in the Emirates you are planning a great expansion of your manufacturing sector to balance your oil revenues, as we heard last night. and I'm saying that the lesson we learnt in the UK, was that, if we plan our economy in the future, we must plan appropriate education to go along with it. Secondly, of course, the converse of that - educational training must be planned with and for the labour market, not in some separate ivory tower. If high quality technological education is to be delivered at all levels, employers must be involved, not only in the planning but also in the delivery of education and of training.

Total co-operation between governments, the providers of education and training, the employers, is essential if we are to deliver a qualified work force. It is my strong belief that the best guarantee of quality is that involvement of employers with industry and commerce in the provision of education and training. Somebody said earlier in the conference, employers are hard men and women. They only put their money where they know they will get value. Therefore the best judge of value, it seems to me, is the willingness of employers of large industries and small businesses to put their money and their time, which is also money, and their interest and effort into the provision of education and training.

It's not enough simply to think of higher education by itself. You have clearly in this country, a key to the very high standards of education in your higher technology colleges, only because you have thought first, as we have to think first, about the base on which higher education rests. The first priority for any country is basic education. The production of a literate, numerate and flexible work force, as His Excellency said this morning, is the first requirement for building quality in the higher technological training system, which we are addressing.

In the UK, we have introduced an introduction to technology for children from the age of five. Our national curriculum now runs right through our school children from 5 to 16 and even our youngest children at the age of 5, have an element in their curriculum which is to do with technology. How surprising you say, how can you teach technology to five year olds? I would invite you simply to think as I do when I think of a small four-year-old little boy or girl, or a three-year-old, and their fascination with wheels that go around on the cars that move. I remember my own eldest son when he was about four, coming up and pressing his nose against the television set as the cars went past, wanting to see how the wheels worked. How many times have we found the toys torn apart because they wanted to see how they work. Children are naturally fascinated by the technology which is around them and we can capitalise on that rather than bring them into school and saying "don't play". We can encourage them to use building, making, creating toys which feed and fuel their interest in technology so that they are ready then to move on to the secondary schools where technology becomes a more formal part of the curriculum.

The philosophy of technology in our secondary schools is expressed in three words "design, make and then evaluate." So we encourage from the very beginning, our young people to design for themselves. To use the principles of good design in their technology to make the thing which they have designed so they learn the practical skills and the problems of actually putting a design into practice and then to evaluate what they have made. Why isn't it working very well? Why is it working better than the one I made before? So, from their experience, they can learn.

Now, of course, to create this kind of technology in the curriculum, we need good teachers who are themselves, technologically aware. One of the difficulties that we faced, and I will guess it's not an unusual thing, in many countries, is that our elementary and primary school teachers, as we call them, were themselves very technologically timid. They were rather afraid of technology. Our, and I hate to say, as a woman, our education as women, for the generation who are now teaching, did not include very much technology. Women in our country, certainly are often encouraged to feel that they are not very good, at fixing things and designing things, and making things that were sort of "chaps" stuff. Yet, those are the women that are teaching our young children, and our secondary schools, and it's very important that the teachers themselves feel comfortable and at home and excited by technology, and that comes back to the training that they are given. Not only for those who are coming out new into the teaching force, but for those for those already teaching, it needed a very intensive programme of updating and giving them confidence in the technologies which they were to pass on and share with their people.

Along with technological education, of course, are the applications of technology and vocation. So, vocational applications and vocational education, which again brings the employers back into the picture, became a very high priority for us as well. We have tried at all levels in the educational system to involve employers, not only in helping us to plan the curriculum, as they did, but also in actually providing experience of the applications of technology in their own workplaces. It's a lot of fun for young people to see that the kind of technology they are learning in school is actually something which is used in daily practice. The control technology of industrial processes, for example, which they learn about in theory at school, they can go to the local businesses and local technological new high tech industries, and see these things being designed; the new control systems, the new software, and so on. It is for them a natural bridge from what they are learning to the kinds of jobs that they might do.

Now that's taken me up to higher education and it may surprise you as one who has worked most of her life in higher education, that I leave that towards the end of what I say. I hope I've made it very clear that I don't believe that we in higher education can get things right unless the base on which we build has been got right first. Having said that, at the beginning of the 1980s, we in the UK were only offering opportunity of higher education to about twelve and one-half percent of our school-leavers. Now that was simply not enough for the demands for a modern, technological economy if we were going to become globally competitive again, and we have indeed, done so. I think we're now the most competitive economy in Europe. We did so on the back of a huge expansion of our higher education.

Our Confederation of British Industry, which is the lead body of our employers, has told us that we should move towards a minimum of 40% of all young people leaving school achieving at least a first degree. We have expanded in the last seven or eight years to 30% of our school-leavers coming into higher education. About one in three of our school-leavers now comes on into higher education. We think at the moment, that's probably about right, because there's always a discontinuity between the expansion of the economy and the supply of highly trained people and we don't want that discontinuity to be too sharp. But we shall expand to 40% I'm quite sure in the next decade and perhaps before, in order to accommodate that one third of the young people leaving school.

The higher education itself has had to change in its nature quite radically. We used to think of higher education as mainly non-vocational, as purely academic, with perhaps a few of the old and respected professions, like law and medicine, finding a place in the old universities. We have created a whole raft of new universities now, which before, some of them were called, polytechnics, some of them called colleges of higher education and so on, but which are all vocationally orientated. Degrees in things which the old universities have never offered before. Things like retail management, hotel management, leisure, tourism, accountancy, terribly important parts of the economic picture. These have all been offered in the new universities and I may say, have been hugely popular with young people and their parents.

One of the other important things which has happened, is that people who themselves perhaps, missed out for various reasons, because the provision of higher education was fairly narrow when they were 18 or 19, are now coming back into higher education. So, last year for the first time in the history of the U.K, slightly more than half the entrants to higher education to universities, were people over the age of 21. So we are getting a big population of people now which is wonderful for the country's economy. A big population who are in mid-career or who are in their late-twenties, early-thirties, who are now coming back to get themselves fully vocationally and technologically qualified, so that they could came back at a higher level in the work force.

I know that here in the Emirates you are very anxious to ensure that your own nationals have the high positions and the well qualified positions in your economy. This kind of passion is one which ensures that that happens. That the highly qualified section of the economy, as it expands gradually, grows and prospers by the products of your higher education system.

As I have said, education alone is not enough. The system of training which we have introduced, which my colleague John Hillier spoke about this morning, has also been on offer not only for young people, but also for people already in work. That again, as he told you, has been entirely employer-led. So I would say, the guarantee of our quality more than anything else, has been the involvement of employers.

One last word; a vital part of a successful economy is the way in which businesses and industries are managed. Unless we invested in management training we could not have achieved the economic success that our country currently enjoys. Management training is an essential ingredient of the economic success. The people who run small or large companies need new skills to run fully market oriented businesses to compete in this ever shrinking global economy.

Modern management is also trained to commit themselves to what we now call a "*learningorganisation.*"

The UK's experience of a programme, called "Investors in People," has illustrated that as the new technology has developed at a frightening speed it is investment in the skills of the work force, which is the most urgent feature for success. The rewards, as we have found, for any country moving in this direction, are of transition to a fully competitive, technologically sophisticated economy, and that is a prize worth major investment.

Assuring Quality in International Education: An Institutional Perspective

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Delegates to this conference will be aware that the stakeholders in higher education — students, staff, employers, governments and the international community are increasingly interested in the standard and quality of education and training provided by higher education institutions.

Over the past decade, because of the growing internationalism of society, there has been a rapid expansion of international activities undertaken by higher education institutions. Much of this work is conducted in the face of intense competition as more and more universities are attempting to raise their international profile and contribute more effectively to global education and training.

The expansion in collaborative international activities has been stimulated by the increasing demand for self-reliant graduates, technologists and scientists in particular, with a global perspective. Institutions have therefore developed robust quality assurance systems to assure all interested parties the services offered are satisfactory and meet appropriate standards.

The Nottingham-Trent University facilitates access internationally by:

- the franchising of undergraduate and postgraduate programmes designed and operating in Nottingham to institutions in over 10 countries;
- the development of joint undergraduate, postgraduate and professional programmes, mainly in Europe;
- and through the provision of a validation/accreditation service, whereby the University validates the programmes designed and operating at institutions in 10 countries.

My paper this afternoon focuses on some general principles and a framework for assuring the quality of international collaborative activity and reports in particular on a case study of franchising of engineering and science programmes to Malaysia.

Foremost in Nottingham-Trent's approach, regardless of the nature of the collaborative activity, is that considerable forward planning is undertaken in the selection of our academic partners. The key principles are a relationship based on trust with like-minded institutions that share a similar mission and values and with a common sense of purpose. A commitment to applied and relevant programmes of study, teaching and research excellence and life-long education is paramount.

The case study I am presenting this afternoon concentrates on the franchising of engineering and science programmes to a consortium of five private Malaysian colleges. My paper focuses on the Quality Assurance arrangements for the maintenance of standards and assessing the quality of learning outcomes from the viewpoint of both the University and the Malaysian colleges.

The particular model of programme franchising is that of franchising by licensing of programmes which have been designed and are operating at Nottingham-Trent to institutions in Malaysia.

The University's approach is based on the policy objective of enabling Malaysian students to study and complete the Nottingham-Trent programmes entirely in Malaysia, without incurring the considerable costs associated with travelling and studying in the UK.

Franchising provides:

- Increased participation by broadening access to higher education
- Expanding provision at low cost at a time when there is limited opportunity for growth in the University
- An opportunity to strengthen international links and enter new markets
- An opportunity to work more closely with other educational providers
- An additional source of income

For the Centre, the benefits are as follows because franchising provides:

- A means of acquiring new programmes at least cost
- Delivering a programme with assured standards
- An opportunity to work more closely with other educational providers
- An opportunity to enhance staff experience/staff development and quality assurance processes
- An additional source of income.

The quality assurance approach used by the University for the approval of franchise arrangements is based on the principles relevant to the delivery of high quality academic programmes and by the experience gained in franchising programmes to over 30 institutions in the UK and overseas.

Our experience has confirmed that the University needs to conduct a formal validation event which determines whether the centre is suitable for the operation and delivery of a franchise arrangement. Furthermore, the University has learned that thoroughness at a franchise validation even minimises the risk of serious problems arising later.

The validation event involves a site visit to the franchise centre undertaken by a 'peer group' of University staff with appropriate subject expertise of franchise arrangements. In addition the panel includes external peer group representatives from industry, commerce or academe.

The exercise has to establish whether the franchise centre has the quality assurance systems in place and the resource base to underpin the delivery of the programme.

Also to establish the means by which the academic studies will be maintained and to ensure that robust inter-institutional arrangements are clearly set out with distinct channels of authority and responsibility.

We have found that these arrangements are best formally recorded in a Memorandum of Co-operation which is lodged with both parties.

The panel seeks to ensure that:

- the college has effective management and administrative arrangements for the delivery of the University's programmes including a programmed committee which monitors the operation of programmes

- communication and liaison mechanisms which are clearly understood
- the resource base to underpin the course to be franchised is adequate and suitable, including physical accommodation, finance, academic and support staff
- teaching and learning strategies are appropriate for the level of the programme and that staff development policies are in place continuously to develop programmed delivery styles and methods
- the college has adequate and effective teaching and learning support, including library provision, computing and other resource based learning, and that arrangements for pastoral care and counselling support is satisfactory.

The quality assurance arrangements which the University has put in place for franchised arrangements are developed to ensure academic standards are comparable to those at Nottingham-Trent and include:

- a common programme committee with joint membership of University and franchise centre staff which co-ordinate the overall management, operation and development of the programme
- regular liaison between programme team leaders at each institution, through designated co-ordinators
- shared teaching and learning strategies based on common programme materials and reinforced by joint staff development activities
- joint programme development through the annual monitoring process
- common assessment strategies, including common assignments and examinations set and moderated by the University
- a common external examiner who considers the achievement of all students on the programme, wherever it is delivered
- a common Board of Examiners which meets to make recommendations of all students enrolled on the programme, wherever it is delivered.

The academic collaboration established in Malaysia has been in operation for over six years and is centred on five private colleges in Kuala Lumpur. This development is supported by the University's office in Malaysia which co-ordinates the franchising operation and facilitates the exchange of information.

Support for the franchise arrangement is provided by a programme of staff and professional development which is designed to ensure the maintenance of quality and standards and includes:

- Annual visit by heads of Malaysian colleges to Nottingham-Trent
- Annual visit by Malaysian programme leaders to Nottingham-Trent
- Two visits per year to Malaysia by Nottingham-Trent programme leaders
- Annual visit by external examiner to Malaysia.

The Nottingham-Trent franchise programmes are popular with students because they are aware that the programmes are 'kitemarked' with the University's quality and benchmarked through the external examiner system.

The University has over the past six years graduated over 1,400 students who have passed science and engineering programmes at diploma level.

Currently the University has over 1,000 students studying on its programmes in Malaysia. The most popular programme is a diploma level course in electrical and electronic engineering with over 500 students.

The University is very satisfied with the arrangement and has pleasure in reporting that in the last three years over 350 electrical engineering students have chosen to travel to Nottingham to complete their studies for an honours degree.

The academic standard and effectiveness of the University's quality assurance arrangements in Malaysia can be gauged by a comparison of the performance of Malaysian students and UK based students on the diploma in electrical and electronic engineering which is subject to identical examinations and assessment and common external examiners.

Student Achievement (%)	*NTU*	*IM*	*LIT*	*ITP*	*WIT*	*KBU*
Distinction	3	50	80	64	34	51
Merit	45	44	20	26	56	45
Pass	52	6	0	10	10	4
Average Mark	54.7	69.6	73.5	70.3	67.3	70.4

The data show that only 3% of Nottingham-Trent students obtained distinction grades whereas 50% of students at IM obtained a distinction grade, 80% (LIT), 64% (ITP), 34% (WIT) and 57% (KBU). Overall the Malaysian students performed at a much higher level than students based at Nottingham. This is demonstrated by the low average mark at Nottingham-Trent, which was 54%, compared to 705 at IM, 73% (LIT) 70% (ITP), 67% (WIT), 70% (KBU).

Analysis of student performance in individual modules revealed that Malaysian students achieved significantly higher marks in comparison to Nottingham-Trent students in the subjects of Automatic Control Systems, Linear Electronics, Digital Electronics and Microcomputer Principles.

There was only one subject area where Nottingham-Trent sudents achieved higher grades than students studying at Malaysian Colleges and this was in the area of application packages.

In conclusion: This information demonstrates, in terms of student performance on a programme which is identical in content and assessment and moderated by the same external examiner, the success of the University franchising operations. It has clearly established that quality assurance arrangements can ensure the quality and learning outcomes of engineering education undertaken by long distance programme franchising.

This collaborative arrangement is considered to be a success from the viewpoint of both the University and the Malaysian Colleges as the graduating students readily gain employment in the rapidly growing Malaysian economy.

Views from Different Hilltops: Getting the Indicators Right in Educational Quality Assurance

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Introduction

In the last ten years, the debates and developments associated with 'quality assurance' in further and higher education have been diverse, complex and heated, and they have entered all corners of the higher education domain in many countries. They have been discussed in thousands of documents, including books, international and national journals, conference proceedings and government reports. In some respects, the issues are so complex, that it can be difficult to discuss or write about any one or two issues, because of the relatedness of so many other issues. Nevertheless, as authors and interested parties, that is what we must do.

In this short paper, the main issue of interest is educational *quality indicators* (QIs) for further and higher education programmes and programme providers. Before proceeding, a broad description of a "quality indicator" is warranted. Scriven (1991) provides a good general definition of an 'indicator' as being:

> A factor, variable, or observation that is empirically connected with a criterion variable; a correlate (p. 193).

A relevant example of a QI would be the *overall judgement* by a cohort of senior students or graduates that a programme has been valuable to them for professional preparation. The *judgement* is an indicator of the criterion variable *value of the programme for professional preparation*, and would be one indicator of programme quality.

It is necessary to circumscribe the discussion in this paper in order to focus on a more specific question and its implications for choosing educational QIs. This questions is—*How do we rationalise the various perspectives on educational programme quality which key stakeholders have ?* Key stakeholders are commonly regarded as including students, employers, professional associations and educationists.

By restricting the discussion (mainly) to a consideration of quality at the level of the educational programme, stakeholders and QIs, many other broader political and philosophical issues concerning educational quality assurance are ignored. In any case, as indicated above, there is a vast theoretical and practical literature which does cover this broader landscape. A minute sample of this literature which provides a useful insight into the range of related issues includes Boyle and Bowden (1997), De Weert (1990), Dill (1992), Goodland (1995), Green (1994), Warren-Piper (1993) and Yorke (1991).

There are at least two good reasons for focusing on QIs at the programme and institutional levels. First, we know from abundant research that this is where the strongest influences are on the *quality of student learning*, both the experience and the outcomes. Optimising the achievement of high quality student learning is the primary purpose (core business) of educational institutions. Secondly, in many communities across the world there has been a strong trend towards greater linking of programme curricula to the needs and views of employers. This has been a necessary and desirable trend in the view of large portions of the communities. As an educationist, I have striven for many years to support such a trend. Nevertheless, care must be taken. Given a range of pedagogical and socio-economic issues, it is critical that a delicate balance be struck between a wider set of student-graduate needs and the needs and views of employers and other community groups. Graduates and students of today need to be prepared for career paths which are likely to be much less predictable and which will require a much broader and diverse range of skills and attributes than were required in earlier generations. The hilltops from which stakeholders in further and higher education view educational programme quality are in different parts of the landscape, and they provide significantly different perspectives on programme quality.

While limiting the scope of the issues discussed to QIs and stakeholders, it is valuable to provide at least some backdrop or frame of reference for this. To do this, a brief discussion is provided of some of the meanings of "quality" in the further and higher education context. Secondly, commonly identified broad functions of an EQA system or approach are described briefly. The overall purpose of QIs is to serve such systems. Thirdly, some of the key elements of an EQA system are identified. These issues have major implications for thinking about, building, and using educational QI sets.

The focus of the TEND Conference is "Technological Education." While most of my career has been concerned with this sector, the discussions presented in this paper are relevant to most if not all fields of further and higher education. If anything, the issues considered are even more important for technological education. Rapid technological and work-place change is a major condition which supports this view.

Meanings and Views of "Quality"

This topic itself has generated wide and diverse discussion over the years. Excellent summary accounts relevant to the context of further and higher education are provided by Ball (1985), Dill (1992), Green (1994) and Perry (1991). Here, only a few comments are provided in order to establish the backdrop for further discussion of educational Is.

Green (1994) provides an excellent commentary built on findings and ideas generated, in part, through the Quality in Higher Education (QHE) Project in the United Kingdom. In the executive summary of one of the QHE documents (1992), of which Green was a co-author, the following passage is noteworthy.

> There are a number of ways of viewing quality. Traditionally, quality has been linked to the idea of exceptionally high standards. A second approach to quality sees it in terms of consistency. It focuses on processes and sets of specifications that it aims to meet. Quality in this sense is summed up by the

> interrelated ideas of zero defects and getting things right first time. A third approach to quality relates it to fitness for purpose. In this approach, quality is judged in terms of the extent to which a product or service meets its stated purpose. A fourth approach to quality equates it with value for money. At the heart of the value for money approach is the notion of accountability. Public services, including education, are expected to be accountable to the funders. A fifth view of quality sees quality as transformative. Education is not a service *for* a customer but an ongoing process of transformation *of* the participant. This leads to two notions of transformative quality in education, enhancing the consumer and empowering the consumer (p.1).

Each of these general perspectives on quality can be seen as being important. Standards and fitness for purpose, are both widely held as providing sound bases for defining quality in education. However, Perry (1994) provides a powerful commentary on the lack of wisdom of a view of quality which is tied to a sense of absolute, traditional or connoisseurship based standards, or a unitary set of purposes.

> It would be wholly inappropriate to expect the models of Oxford and Cambridge to determine our expectations towards all higher education in the United Kingdom. Indeed, it can be argued that a vague and ill-defined belief that there is something absolute in, for example, the quality of the British first degree, has been a hindrance and not a help to our development as a modern advanced society in the latter part of the twentieth century. Accepting that the target for quality standards will vary from one institution to another, throws into sharper relief the importance of the mission statement (p. 31).

Given a diverse range of socio-economic conditions, there is a clear and increasingly well recognised need for institutions and programmes to vary their missions and purposes more and to express them in clearer terms. Accordingly, the ways they define and evaluate quality for their enterprise also need to vary.

One other closely related issue concerning both the "standards" and "fitness for purpose" view(s) of quality is worth noting here. Boyle and Bowden (1997) stress the need to recognise the dynamic nature of quality, particularly in the educational context.

> Levels of quality and the notion of quality improvement need to be conceived of in dynamic terms. The quest for quality in any activity is a constant struggle to maximise the extent to which goals have been achieved despite constantly changing contexts: contexts which not only affect both process and outcome but also catalyse changes in goals. Quality is never attained in an absolute sense; it is constantly being sought (p.4).

Quality as consistency is also useful in the educational context, though the nature of education as an enterprise requires a more sophisticated perspective to that often applied to other enterprises which involve more discrete and constant products and services. Educational institutions usually see themselves as professionally bound and in many contexts they are legally required, to ensure that (for example) students are treated in a consistent manner in a range of respects. Examples include access to resources and support services, fairness and consistency in assessment and consistent treatment in relation to learning-teaching activities. At the same time, quality and diversity are not contradictory and education and learning are not processes of the same kind as production or service line processes. They must allow for a range of educational-discipline culture and process differences. They must recognise learner diversity, differences in views of knowledge and learning within and across programmes and disciplines, and issues such as creativity and the need for enrichment for some students and remediation for others. Too strong an emphasis on consistency, at any level, constrains or obstructs such conditions and practices, which are widely viewed as being part of best practice in education. In other areas of institutional functioning such as personnel management, student admissions and records, etc. the "consistency" view of quality is more directly relevant than in the learning domain.

The "value for money" or efficiency notion of quality is one which is central to funding bodies (government) in particular. While pressure for greater "access" to further education and increasing competition for public funds exist, there will be a need to incorporate this view of quality in any practical approach to EQA. Students, parents and employers as 'customers', also often have a strong orientation to a value for money perspective on educational quality, albeit in different and more idiosyncratic ways.

Finally, the transformative view of quality needs to be taken more seriously in many places. It stresses goals such as creating experiences and environments for students which will enable *them* to add value in terms of their competencies, including learning competencies (e.g. adaptability, life-long learning skills), rather than goals such as the 'delivery' to the student as 'customer', by a provider, of a narrowly defined package of content and skills. Much more emphasis is placed on learner empowerment and student as manufacturer of learning, rather than student as receiving customer.

Given these different perspectives on "quality", in the end, a pragmatic approach to EQA requires accommodation and rationalisation. Green's (1994) comments support this view.

> ...quality is a relative concept, ...different interest groups or 'stakeholders' in higher education have different priorities and their focus of attention may be different. The best that can be achieved is to define as clearly as possible the criteria that each stakeholder uses when judging quality, and for these competing views to be taken into account when assessments of quality are undertaken (p. 17).

Functions and Key Elements of an Educational Quality Assurance System

Functions of Quality Assurance

Distilling from the international literature, it is possible to propose two or three broad functions and features which tend to be viewed as desirable for an effective EQA system at the institutional-programme level.

a) An educational programme QA system (institutional level) should ensure that 'quality assurance' means and incorporates the designing in, maintenance, and continual improvement of quality (including standards) in student learning outcomes and experiences, as well as the processes and elements which enable this to happen *(Quality improvement function).*

b) An educational programme QA system (institutional level) should ensure that the institution has a high level of corporate confidence in the levels and consistency of quality in student learning experiences and outcomes, and its graduates' competency and attributes profiles across the institution *(Accountability, for quality, function).*

c) An educational programme QA system can also incorporate a framework for ensuring that the institution is using its resources in an optimal way to achieve its quality and other strategic goals. This function can also operate through an alternative sub-system of financial and strategic planning and management, which in any case should be strongly linked to the programme QA system *(Efficiency and financial accountability function).*

A common and simplified view of the *role* of effective "Quality Assurance", either expressed explicitly or implied, is also useful for our purpose here.

- To ensure that real and systematic continual quality improvement is achieved in core processes and principal outcomes.
- To 'reassure' external agencies or clients about issues concerning quality and performance.
- To promote organisational culture change towards quality.

This paper cannot explore these functions and roles further. However, an awareness of them is important for a consideration of quality indicators. Several issues concerning the place of information (and "indicators") in quality assurance are clear when these functions are examined.

First, information, evaluative and descriptive, is central to quality assurance. Secondly, information is needed which guides actual improvement and which enables accurate summative statements about quality to be made. Thirdly, in the educational field, the nearest equivalent to what is referred to as "core business" in the commercial world, is the enabling of high quality student learning, so *student learning needs*, in terms of process and outcome, need to be the primary focus of EQA. Yet, "external agencies" are involved as key stakeholders (e.g. government ministries, employers). Thus, information on quality issues needs to concern and be obtained from more than one stakeholder and perspective.

Key Elements of an Educational QA System

Again, there is not the space in this paper to discuss the elements and processes of EQA systems. Brief mention is made of some of the key elements required for an effective system in order to complete the backdrop for further discussion of QIs. It should be noted that in only identifying system *elements*, a range of *conditions* which are critical for a "culture of quality" to exist are largely ignored. Such conditions, which need to complement QA system design, include: an ethos of trust, responsibility and empowerment; valuing of leadership as motivation and support, rather than power and coercion; explicit valuing of continual learning and improvement and an expectation that all personnel should be actively engaged in this; mutual respect and support; and real collaboration and team based approaches.

Approaches to EQA need to be based on a system of integrated elements which focus on the *maintenance and improvement of the quality of student learning*. Consistent with most widely accepted perspectives on QA, these elements need to address the broad but critical issues of mission and leadership, design, processes and outcomes, in relation to this core function, and those functions which support it. This means that the following elements need to be incorporated, in an integrated way, in an EQA system.

a) Overall vision, mission, key values and goals, and strategy.
b) Effective leadership, and expectations and systems for leadership development.
c) An explicit and dedicated sub-system and set of processes and criteria for quality... assurance at the *educational programme (student learning) level*.
d) Strategic and comprehensive people development policies and programmes.
e) A comprehensive and systematic quality information base.
f) A comprehensive, support oriented performance management system.
g) Organisational structure and functional design which maximises the effectiveness...of all groups in supporting the core function.
h) Clear processes and expectations which enable continual quality improvement.

The element of most relevance in this paper is the "comprehensive and systematic quality information base". The quality information base serves not only as a dynamic repository for information but as a hub which both provides access to information and enables receival and organisation of information associated with other elements in the overall EQA system. Much of the information in the quality information base will underpin an institution's various QIs.

Views from Different Hilltops: Stakeholders and Quality Indicators

It is clear that given the different views of quality and functions of quality assurance, a range of criteria and quality indicators (QIs) are possible and necessary. In the last five years or so several large scale investigations have been carried out to advance thinking and practice in respect of quality or performance indicators in further and higher education (e.g. QHE Project, UK; Blank Project, U.S.; Alberta Colleges Project, Canada). At the same time, governments and institutions have struggled to develop effective and efficient approaches to the development and use of their QI sets.

Not surprisingly, given the differences discussed above, investigations or development projects on QIs yield a wide range of possible indicators. Most have generated between 20 and 50 different indicators, usually clustered under stakeholder categories (e.g. Government-Funding Authorities, Employer, Student) and level (e.g. Educational system, Institution, Programme). Some examples of these are provided in Table 1. The challenge for institutions is to derive an optimal set of QIs, matched to their particular values and mission, which in turn will be based to a large extent on priorities assigned to various stakeholders' perspectives. While this is a difficult challenge, it is one which must be addressed if educational QA is to be effective and if it is to be seen to be effective, by stakeholders, potential clients and validating and funding bodies.

Table 4: Examples of Commonly Used or Advocated Quality Indicators

Institutional Level

A. Almost universally viewed as "Quality Indicators"

- Explicitness and comprehensiveness of the formal QA system, particularly
- that part which directly concerns educational programme quality.
- Adequacy of physical resources (e.g. LRCs, IT, Learning spaces)
- Adequacy of human resources to support learning and teaching
- Relevance and currency of programme curricula
- Graduate competencies and attributes (stress on employer based views)
- Student and recent graduate satisfaction with learning and programmes
- Graduate assimilation into chosen/relevant fields
- Student progress and completion

B. Often viewed as more related to "institutional performance" re aspects such as efficiency, throughput, etc.

- Growth in completion
- Cost per student/graduate
- Space utilisation

Programme Level

Many is at this level are similar to those at institutional level, but are derived and used more precisely. Some others include:

- Quality and range of student learning outcomes
- Quality of teaching, including the overall professionalism of teachers
- Quality of learning environments: physical and psychosocial
- Clarity of programme and course aims and objectives
- Relevance, coherence, and quality of design of programme curricula, including relevance for vocational and lifelong learning purposes.
- Extent of students' active involvement in and responsibility for learning
- Validity and fairness of student assessment
- Level of transferrable knowledge and skills at student exit point
- Effectiveness of career counselling for students
- Extent to which optimal use of resources has been demonstrated, given programme quality goals

In developing QI sets, institutions must consider many issues or factors, which cannot be assumed or discussed here, including the costs and practical implications of information collection and analysis. Accepting that one of the most critical overall issues is the achievement of a balance, an important consideration is the degree of overlap or difference between the indicators or views of quality of different stakeholders. Three situations or cases can be identified to illustrate this (and see Figure 1).

First, where a number of key stakeholders agree on the importance of a particular QI (e.g. *Graduates leave a programme with relevant transferrable skills*), this provides institutions and programme teams with a strong rationale for incorporating such an indicator in the overall QI set. A second situation is where two or more key stakeholders consider an indicator or criterion of quality to be important, but differ in their interpretation of what high quality will mean. Here, the task of balancing or incorporating both views is important. An example of this can be seen in the common situation where employers as one key stakeholder, and students (and often educational professionals) as another, both view *adequacy of programme content and objectives* as an important QI, but they differ to a greater or lesser extent on what they regard as adequate or high quality (see figure 1 for illustration).

A third case is where one important stakeholder may express the importance of a particular QI, while another does not. This can be a particular problem in the current era, where many institutions are grappling with an increased tension between seeing students-graduates as their primary stakeholders, and the place of employers, as another key stakeholder. In both the second and third cases identified here, judgements and decisions need to be made on how to integrate, incorporate or disregard the various views and indicators of quality.

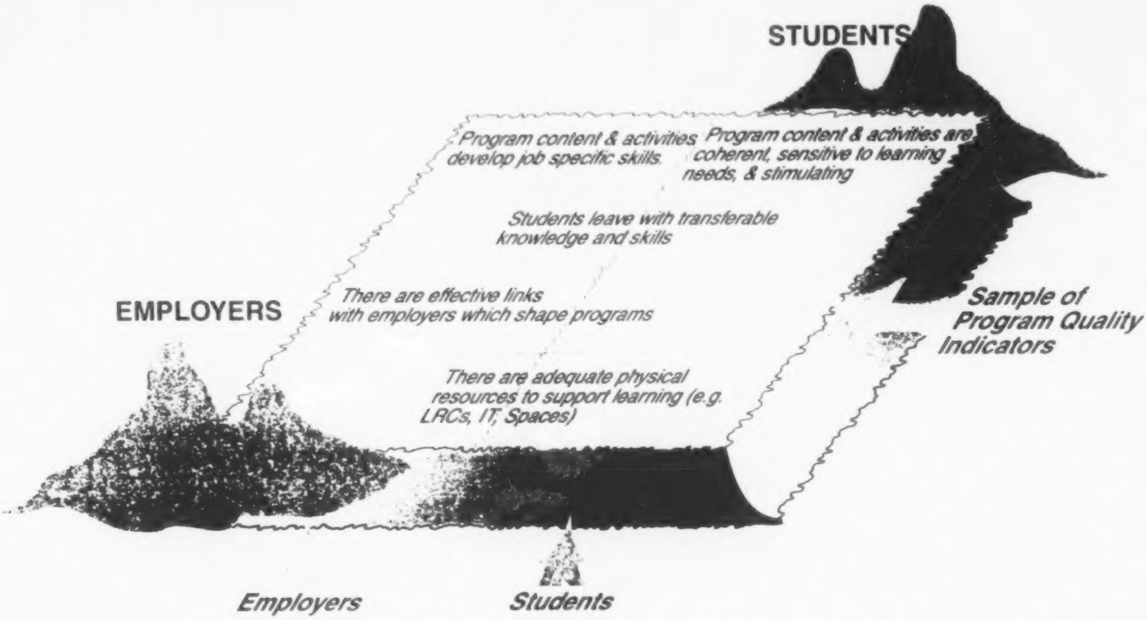
STUDENTS
Program content & activities develop job specific skills
Program content & activities are coherent, sensitive to learning needs, & stimulating
Students leave with transferable knowledge and skills
EMPLOYERS
There are effective links with employers which shape programs
Sample of Program Quality Indicators
There are adequate physical resources to support learning (e.g. LRCs, IT, Spaces)
Employers
Students

Fig 1: Program Level Quality Indicators - Stakeholder Differences

Figure 1 serves to illustrate further this issue or difficulty faced when seeking to derive an optimal educational QI set. By focusing on two stakeholder groups which are commonly regarded as primary, students and employers, it is possible to see clearly some of the commonalities and differences in views of quality these groups often have. The small sample of QIs (4) illustrated in figure 1 includes indicators which are relatively unproblematic in terms of their importance, as perceived by different stakeholders. Internationally, a large and growing proportion of educational institutions now view all of these indicators as being important for their quality assurance processes. Nevertheless, with the exception of the indicator *Students leave with transferable knowledge and skills*, there are often considerable stakeholder group based differences in the weights assigned to or interpretations of the other three indicators in this set.

Further, such a small set would never be seen as being sufficient for serving

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effectively the various functions of a comprehensive EQA system. Several other indicators would be needed to complement these. At the same time, given the need for cost-effectiveness and manageability of information, the total number of indicators used needs to be kept relatively small. The challenge for institutions and programme teams is to derive an optimally effective set of educational QIs. This means having a set which provides *valid indicators of quality,* where quality is defined in terms of the articulated key values and purposes of institutions and programmes. These in turn need to be based on a careful prioritising and consideration of the views and needs of key stakeholders. In any case, *student learning* should remain at the centre of all considerations and practice.

Conclusion

Educational QIs are a necessary and important part of any comprehensive EQA system. Overall, a set of QIs needs to be useful for both informing improvement, at either programme or institutional level, and for answering summative questions about quality. More global indicators are usually accepted for enabling accountability requirements to be satisfied. There are many excellent indicators, quantitative and qualitative, which can be chosen and used by institutions and programme teams. However, because of the need to consider costs of various types associated with information collection, analysis and use, institutions and programme teams need to be discriminating in their selection of which quality indicators to use.

At least of equal importance in this selection problem, is the fact that there are many different legitimate perspectives on "quality", both at the general level of the purpose(s) of further and higher education, and at the level of programmes within particular institutional contexts. Further, while considerable agreement exists in many communities, different stakeholders in the higher education sector, and in particular programmes, often have different views on what indicators of quality should be, or on how to specify or interpret those indicators.

Institutions and programme teams are clearly faced with a challenge to set their priorities in terms of views of quality, linked to their primary purposes and the weights they wish to assign to various stakeholders. Usually it will be necessary to strike a balance when establishing an operational set of quality indicators. Indicators will need to be chosen which will enable the views and needs of key stakeholders to be determined, considered and used over time to enable both the improvement and accountability functions of EQA to be achieved. A particularly difficult problem, being encountered more and more, is how to rationalise the short and longer term learning and life-skills needs of students and graduates, with the needs and views of quality which employers have.

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Operating Decentralised Education Systems and Maintaining Standards: Experience in England

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Introduction

In England and Wales, the arrangements for vocational education have been reorganised radically in recent years. This paper outlines the nature of the changes and describes how, in what is now a very decentralised system, national government seeks to ensure that key aspects of the system are operating satisfactorily.

1. The System of Vocational Education in England

1.1 Vocational education, or further education as it is more commonly referred to in Britain, has traditionally been provided in specialised colleges. Young people leaving school intent upon obtaining a qualification before starting their career, or older workers wishing to improve their qualifications, may choose from a wide selection of courses, many of which are available on an either full-time or part-time basis.

1.2 Until five years ago those colleges were run by the local education authority. A significant change took place in 1992 when the government decided to decentralise the arrangements so that each college became independent and responsible for its own strategy under the authority of a board of governors. At the same time, the Government established a national funding council, the Further Education Funding Council, to develop an overall strategy for vocational education and gave it the task of distributing government funds to the colleges.

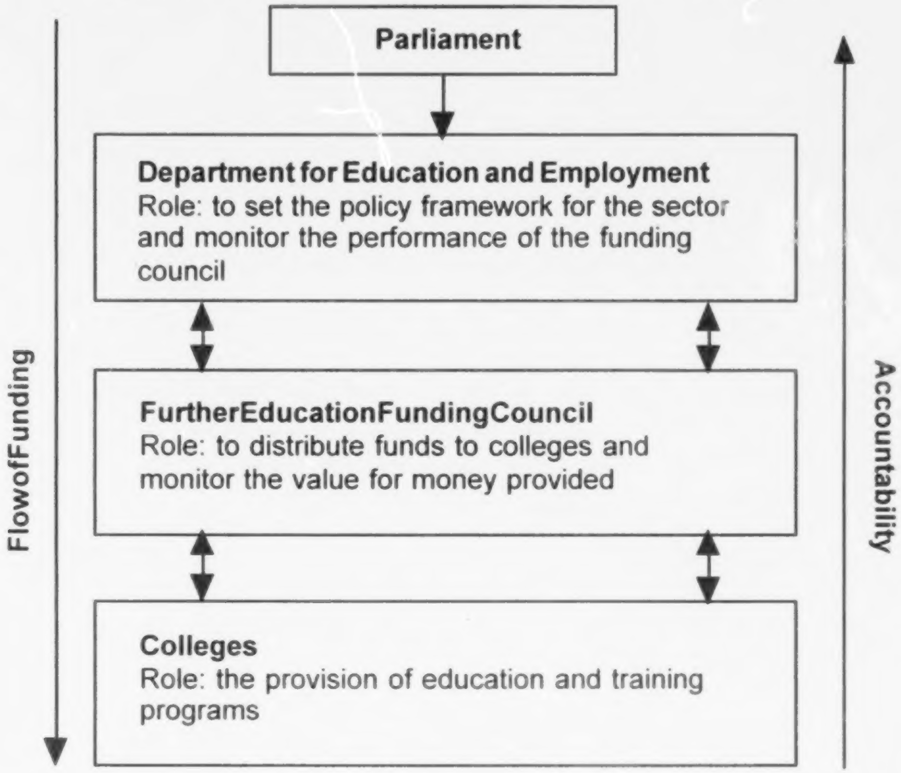
1.3 The funding council is also responsible for:

- ensuring that colleges have appropriate arrangements for financial management and accounting;
- promoting value for money through the grants paid to colleges and
- monitoring their financial health and borrowing.

1.4 The government introduced this major change because further education, which hitherto had been a relatively unnoticed part of the education system as far as the general public had been concerned, had come to assume more significance because of increasing political and business awareness of the importance of having a highly skilled work force capable of operation at high international levels of competence. It concluded that each college would be more likely to respond effectively both to local business and industrial requirements for vocational education and be more sensitive to student demands for places if it were also responsible for planning its own future and financial affairs.

1.5 As a result of this major change, the distribution of responsibilities for further education in England and Wales between the centre and colleges now is as shown below:

Responsibilities and Accountabilities in Further Education


Parliament
Department for Education and Employment
Role: to set the policy framework for the sector and monitor the performance of the funding council
FurtherEducationFundingCouncil
Role: to distribute funds to colleges and monitor the value for money provided
Colleges
Role: the provision of education and training programs
FlowofFunding
Accountability

1.6 There are regulations, called financial memoranda, which govern the financial relationship between the body making the grant and the recipient of funds. They specify the terms and conditions of funding and require recipients to have in place sound systems of financial control.

1.7 The Government's main aims in relation to further education are:

- to increase the proportion of young people participating in high quality education and training, in a way which encourages institutional efficiency;
- to give colleges the freedom to respond flexibly to the demands of their customers;
- to promote parity of esteem between academic and vocational qualifications; and
- to make good quality education available to adults to help them improve their qualifications and update their skills.

2. The College Network

2.1 At present there are almost 500 colleges in the further education sector in England. They provide education and training for some three million students a year.

2.2 Colleges offer a wide range of programmes in three broad categories:

- General education, including courses leading to qualifications which give access to higher education;
- Vocational education and training; and
- Higher education, including courses leading to a professional qualification.

2.3 In addition, many colleges provide a wide range of leisure and recreational courses which do not lead to a qualification. Most colleges also offer courses organised specially to meet the requirements of local employers.

2.4 The sizes of individual colleges vary widely. The majority of colleges enrol between 2,500 and 6,000 students a year and are based on between one and six sites, but the largest would have more than 20,000 students. There are some colleges which specialise in a sector of education e.g. in agriculture. These are smaller, enrolling between 500 and 1,000 students.

3. Securing Sufficient Facilities

3.1 A crucial dimension of any national system of education is to ensure that there is, throughout the country, adequate provision to meet the likely demand. In that phase of education where attendance is compulsory i.e. primary and secondary school, demand is relatively easy to quantify being equal to the number of children who live in a community and who are of school age.

3.2 It is less straightforward to quantify when attendance is voluntary and when there is a variety of specialist programmes for which the demand can vary according to the choices of individual students and the fluctuating employment opportunities in various industries and businesses.

3.3 To ensure that there was a clear focal point for responsibility about the adequacy of provision in England the law now requires the Funding Council to secure the provision of sufficient facilities for education. Accordingly the Council requires each college to undertake in its area a comprehensive analysis of the likely requirements for vocational education and to review this each year. To do this properly a college has to discuss, in consultation with local employers and schools, the likely future requirements in the area for skilled labour and also to estimate the probable forthcoming demand by young students for places.

3.4 These estimates of demand for places form one element in each college's strategic plan which it is required to provide to the national funding council. The other elements in the plan are:

- a statement of the college's educational mission;
- an operating statement listing short term objectives;
- a three-year financial forecast;
- specific strategies with respect to its accommodation requirements, staff planning and development; and
- a description of its quality arrangements.

3.5 Individual college plans are then collated and considered at regional and national level against known forecasts of employment changes. Thus any signs of shortage of provision at regional or national level can be detected.

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4. Governance of Colleges

4.1 When each college was given its independence the responsibility for its running was allocated to a board of governors. The framework for the membership of these college boards was specified by the Secretary of State for Education. It provides for between 10 and 20 members in various categories. Normally business people must make up at least half of the membership.

4.2 The powers and responsibilities of the governors are laid down in legal agreements. The distinction between the role of the governing body and that of the principal of the college is of especial importance. Whereas the governors have responsibility for the oversight of the college's activities, the principal, as chief executive of the college, has the responsibility for the day-to-day direction of the college.

4.3 The key responsibilities of the governors include:

- the determination of the educational character and mission of the institution;
- the approval of the annual estimates of income and expenditure;
- ensuring the solvency of the institution and safeguarding its assets; and
- the appointment and dismissal of the principal.

4.4 In a decentralised college system it is vital, given the extent of public funds invested, that the government has confidence in the financial arrangements in each institution. Consequently colleges are required to have satisfactory and reliable arrangements for the management and control of their finances. These include management information systems, financial regulations and properly documented administrative procedures.

4.5 Colleges are required to produce and publish annual accounts which must be audited by external auditors appointed by the governing body. They are also required to appoint internal auditors.

4.6 A further scrutiny of the financial position of a college is provided by the Audit Committee, which each governing body is required to appoint. This committee of the governors is expected to monitor:

- the effectiveness of a college's internal controls and the mechanisms for achieving value for money;
- the college's responses to reports from its auditors.

5. Inspection of Vocational Education

5.1 A second key dimension of any system of education, centralised or decentralised, is the quality of the education provided. Under the 1992 legislation the Further Education Funding Council is required to make arrangements for assessing the quality of education providers in the colleges. To fulfil this duty the Funding Council established a national inspectorate to carry out external assessments of colleges by means of a systemic round of inspection visits. The terms of reference for the inspectorate are:

- To assess standards and trends across the further education sector and advise the Funding Council, on the performance of the sector overall.
- To prepare and publish reports on each college.
- To identify, and make more widely known, good practice and promising developments in further education and draw attention to weaknesses that require attention.

- To keep abreast of international developments in post-school education and training.

5.2 The inspectorate comprise full-time and part-time specialist inspectors drawn from business, commerce and industry and people experienced in tertiary education. Each college undergoes a major comprehensive inspection over four years.

5.3 For each four-yearly inspection of a college, a team of full-time and part-time registered inspectors is assembled which reflects the size of the college and the nature of its provision. The college is invited to nominate a senior member of staff to participate in all aspects of the inspection other than contributing to decisions on quality grades for the areas covered by the inspection.

5.4 In advance of the inspection, the college is asked to produce a brief self-assessment report based on the findings of its own quality assurance procedures and covering the aspects on which the inspectors report:

- responsiveness and range of provision;
- governance and management;
- students' recruitment, guidance and support;
- teaching and the promotion of learning;
- students' achievements;
- quality assurance; and
- resources (staff, equipment and accommodation).

5.5 During the inspection, inspectors observe teaching, training and other activities designed to promote learning. They inspect students' work. They hold discussions with, for example, students, staff, governor, parents, employers, representatives of local Training and Enterprise Councils and community representatives. They examine documentary evidence provided by the college.

5.6 Inspectors assess the strengths and weaknesses of each aspect of college work they inspect. Their assessments are set out in the text of the report which they produce on the inspection and are summarised using a five-point scale where grade one represents the highest quality. Grades are assigned to the curriculum areas inspected and to the cross-college aspects of provision.

5.7 A four-yearly inspection can extend over several months, with curriculum areas being inspected on a staggered basis. In the first three years, each inspection took an average of 68 inspector days. The team inspection, covering cross-college aspects, is normally the culmination of the inspection visit.

5.8 At the end of the inspection, the inspector's report is published. The college then has four months to provide a written response outlining plans for addressing any weaknesses identified in the report. The college inspector monitors implementation of the action plan, and, where appropriate, offers advice.

5.9 This four-yearly inspection is supplemented by:

- Three visits a year to each college by a full-time inspector assigned to the college in order to build up an in-depth knowledge of the college and to monitor the college's response to any criticisms made in the inspection report.
- Specialist inspectors which form a particular area of the curriculum e.g. engineering, business studies which lead to national reports.

5.10 These college inspections are now well established and a report has been published on each college. The process has been well received by the further education sector. The reports provide the governors and senior staff with an independent assessment of the quality of education in a manner which enables them to compare themselves with other similar colleges.

5.11 There is an explicit link between the lower grades assigned to part of a college's programme and the process by which the Funding Council distributes funds. A college receiving for any part of its work, any of the two lowest grades, cannot apply for growth funds in that area until it has been re-inspected and its curriculum provision deemed satisfactory.

5.12 These external inspectors are a most important part of the national arrangements for ensuring that throughout the country standards of education are satisfactory. However, they are by themselves insufficient to bring about the delivery of effective teaching and learning. This can only take place if each college is active in meeting its own responsibilities for standards. Consequently the further education inspectorate has been assisting colleges to develop their own internal methods for critical self-assessment. To this end they have this year published detailed guidelines to assist colleges. These are reproduced as an annex to this paper.

6. Vocational Qualifications

6.1 Most students in further education colleges have as their aim to obtain a recognised national qualification. There are three broad categories of FE qualifications—general education, vocational education and training for work.

- General education: includes the General Certificate of Secondary Education (GCSE) and the Advanced General Certificate of Education (A levels) which is the principal qualification for entry into higher education;
- Vocational education: in England the traditional vocational courses are gradually being replaced by the newly introduced General National Vocational Qualifications (GNVQs); and finally
- Job specific qualifications: these qualifications are intended to assist people gain occupation-specific skills and knowledge. Called national vocational qualifications (NVQs) they are awarded at five levels: level three being the equivalent to GCE A level.

6.2 These various qualifications are awarded by examining bodies whose role it is to guarantee the standards of the qualifications. In England and Wales there are three main examinational bodies offering vocational qualifications:

- The Business and Technology Education Council. This body recently amalgamated with the London University A Level Board to form a new organisation called Edexcel.
- The City and Guilds
- The Royal Society of Arts.

6.3 Each of these organisations provides its qualification internationally and maintains branch offices in various parts of the world. Details are available from British Council offices.

7. College Effectiveness

7.1 In addition to the system of inspecting the quality of education the Funding Council is also introducing a series of individual college performance indicators which are calculated for each college.

7.2 These performance indicators were developed:

- to enable colleges to compare their achievements with other equivalent institutions;
- to enable the performance of colleges to be monitored over time;
- to provide information at national level on the effectiveness of the vocational education system.

7.3 These performance indicators attempt to measure effectiveness in the following areas:

- *Students' responsiveness* provides an indication of students' motivation by their college course by recording their continued education on programmes
- *College responsiveness* provides an indication of the extent to which a college is providing programmes which meet the needs of students as reflected in enrolment trends.
- *Student achievements* provides an indicator of the achievements of students at the completion of the courses by recording the extent to which they achieve the qualification aims.
- *College effectiveness* assesses the extent to which a college is achieving its strategic plan by reporting the extent to which it meets the annual enrolment target it has set for itself.
- *Value for money* shows the funding per student at a college in a way which allows comparison with levels at other colleges.

7.4 These indicators are not intended to be accurate stand alone measures. Rather they are expected to be read alongside other information which each college publishes about its activities and must be considered in relation to the college's strategic plan and mission. They provide a useful starting point for colleges, both governors and senior staff, to compare their performances with other institutions.

8. Summary

8.1 The increasing internationalisation of the world's trade has resulted in a much enhanced awareness by national governments of the importance of a highly skilled work force. Systems of vocational education have a crucial part to play in bringing this about. In England it was concluded that the colleges providing vocational education would be more capable of responding to the changing requirements both of employers and young people, if they were given more freedom to manage themselves. As a result, independent colleges under the control of a board of governors, have been established. These colleges are responsible for determining their own strategic plans and their financial affairs. The board of governors must agree a strategic plan for developments in this area, be accountable for the public funds they receive and monitor the work of the college executive.

8.2 So as to assure the government that there is sufficient provision of high quality education in each locality, a national inspectorate reports regularly on the quality of each college's education.

8.3 This change to a decentralised system of providing vocational education has been accomplished over a five year period with the broad support of colleges and employers.

9. Acknowledgement

9.1 Further information on the following education arrangements in England can be found in the following particulars:

Managing to be Independent: Management and Financial Control at Colleges in the Further Education Sector Report by the National Audit Office, London 1995.

The Further Education Funding Council for England Report of the National Audit Office, London 1997.

Quality and Standards in Further Education in England, 1996–96.

Annual Report by the Chief Inspector, The Further Education Funding Council, Coventry, England.

Measuring Achievement: Further Education College Performance Indicators 1994–1995 Report of the Further Education Funding Council.

Validating Self Assessment Circular 97/12, The Further Education Funding Council.

Annex

Guidelines For Self-Assessment and Inspection

These guidelines have been published by the Further Education Funding Council in England. They are intended to assist colleges undertaking self-assessment and inspectors can assess provision. These have been expressed and can be interpreted, in a way which will enable colleges to accommodate changes in their provision which they may wish to make in response to recommendations found in the reports of national significance.

Since each college is unique, the guidelines are not intended to be exhaustive nor prescriptive and it is not intended that colleges or inspectors should use them as a checklist.

It is recognised that teaching and learning takes many different forms. In order to simplify these guidelines the term "lesson" is used to cover all guided learning activities.

1 The College, and Its Mission

Quality statement	*Indicative sources of evidence*
1a the college has a clear mission, is responsive to the needs of its local community, seeks to widen participation in further education and promotes equal opportunities	mission statement policy statements and college's charter strategic and operational plans labour market research, socio-economic data the views of all customers, including students and members of the local community all aspects of the college's performance

2. Teaching and Learning

2a teaching and learning are planned effectively to meet the needs of all students, achieve standards set by awarding bodies and cover syllabuses	units/modules/syllabuses schemes and records of work course documentation lesson observation and the views of students arrangements to support students with learning difficulties and/or disabilities
2b the aims and objectives of lessons and other learning experiences are clear to students	handbooks/handouts provided to students lesson observation and the views of students
2c teaching sustains students' interest and extends their skills, knowledge and understanding	records of students' progress students' written, oral and practical work lesson observation and the views of students
2d teachers use appropriate methods to meet students' individual learning needs and promote productive working relationships	schemes of work and lesson plans teachers records of students' work students' work the views of students lesson observation tutorial and other arrangements support for students with learning difficulties and/or disabilities
2e teachers give appropriate attention to equal opportunities and the exploration of cultural, moral and social issues	schemes of work and lesson plans the views of students lesson observation tutorial and other arrangements policy statements programmes of opportunities for enrichment
2f within their courses, students have the opportunity to experience and value different methods of learning	schemes of work and lesson plans students' work arrangements for access to suitable learning resources the views of students
2g experience of work, where appropriate, makes an effective contribution to students' learning	records of learning at work, including reports of work experience the views of students and employers use of students' experience in teaching and learning
2h core/key skills, where appropriate, are developed, assessed and accredited	teaching schemes and lesson plans records of core/key skills assessments lesson plans and lesson observation students' work

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2i students attend regularly, are punctual, attentive and organise their own learning effectively	attendance records students' learning agreements and action plans lesson observation students' work
2j students carry out practical work competently and safely	health and safety arrangements instructions to students about health and safety resources to ensure safe working practice lesson observation
2k forms of assessment and opportunities for accreditation are appropriate	assessment arrangements teachers' records lesson observation students' assessed work verifier's and moderator's reports the views of staff and students
2l students understand the purpose of assessments and what is expected of them	handbooks/handouts and assignment briefs provided to students the views of students students' assessed work lesson observation
2m assessment is fair, is carried out regularly and is used to inform students how they are doing and how they might improve	teachers' records of assessments students' assessed work students' action plans and evaluations the views of students reports from examiners and verifiers
2n parents/employers and others are appropriately informed of students' progress	arrangements for reporting on full-time and part-time students
3 Students' Achievements	
3a the college sets suitable targets for the performance of individuals and groups	data on attendance, completion/retention, examination results/other achievements, added value, progression, destinations national targets for education and training
3b students' work is of an appropriate standard and where appropriate demonstrates vocational competence	course documents awarding body requirements moderator's/verifier's reports students' records of achievement students' notes, written assignments and practical work lesson observation views of employers

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3c students perform well in examinations and/or other types of formal assessment	examination and other results the college's analysis of students' results national statistics data on added value data on retention/completion
3d targets for student retention/completion are set and met	analysis of data on retention, completion and progression records of actions taken to improve performance national statistics
3e students' other achievements are recognised and valued	information on awards, prizes, grants, scholarships, projects, performances, exhibitions, sporting achievements students' records of achievement work-related achievements
3f students attain their primary goals in terms of progression, for example, to other further education courses, higher education or employment	students' records analysis of data on students' destinations including further training and employment
4 Curriculum Content, Organisation and Management	
4a the curriculum enables students to achieve nationally-approved standards for education and training	approval documents from national validating and awarding bodies students' work range of programmes and content of curriculum
4b within the context of the college's mission, the curriculum meets the needs of all students, of employers and of other customers	course documentation market research links with industry, other educational colleges, and the local community range of courses and curriculum content the views of students, employers, and others analysis of achievement levels for different groups of students analysis of data on students' destinations, including further training and employment
4c the curriculum is managed efficiently and effectively, and provides continuity and progression for all students	timetables course handbooks data on students' destinations documentation on efficiency measures and targets the views of students
4d students have the opportunity to participate in extra-curricular activities	course documentation observations of students' activities the views of students and staff

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4e colleges fulfil legal requirements in respect of religious worship and education	legal requirements arrangements for collective worship and religious education the views of staff and students
4f there are clear links between strategic planning and the development and management of the curriculum	strategic plan departmental plans course documentation data on students' destinations minutes of departmental meetings plans for, and results of, market surveys the views of governors and staff the views of employers and external organisations
4g off-site learning, franchised provision and distance learning are managed effectively	strategic and operating plans quality assurance arrangements the views of staff and students inspection of off-site provision
5 Support for Students	
5a impartial guidance before and on entry to the college helps students to choose the course which is right for them	publicity materials admissions open events links with schools, careers service, external agencies and employers procedures for the assessment of students' prior learning the views of staff and students observation of recruitment and guidance procedures
5b induction programmes enable students to settle into work quickly and to understand the opportunities open to them, their rights and their responsibilities	induction arrangements information and materials provided for students,—including charters and learning agreements transfer arrangements between courses and records of transfers guidance for teachers observation of induction sessions the views of students

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5c students receive effective learning support to meet their individual learning needs throughout their studies	screening, diagnostic tests and arrangements to follow up the results of these monitoring arrangements support for students with learning difficulties and/or disabilities the views of staff and students arrangements for additional support tutorial or other arrangements guidance for tutors arrangements for the completion of records of achievement observation of tutorials and other support sessions
5d students receive appropriate guidance on the opportunities available to them when they have completed their studies	careers education and guidance procedures and records procedures for applying to join other further education courses and to enter higher education access to appropriately trained staff opportunities for students to meet employers and undertake visits the views of staff and students information about employment opportunities
5e students have access to relevant support on personal issues	arrangements for providing financial advice, counselling for personal, health, moral and social matters, child care and other forms of support which assist students the views of staff and students equal opportunity and disability policies and grievance procedures
6 Resources: Staffing and specialist provision	
6a teachers have appropriate qualifications and up-to-date knowledge	teachers' qualifications and experience documents showing staff deployment across the college lesson observation the views of managers, teachers and students
6b technical and administrative staff are appropriately qualified and effectively deployed to support teachers and students	staff qualifications and experience observation of learning activities the views of managers, teachers, support staff and students' timetables and job descriptions

6c staff evaluate their own performance and are provided with suitable opportunities for professional development	arrangements for staff appraisal and review Investors in People status staff development programmes arrangements for disseminating the information/experience gained through staff development activities resources allocated to staff development the views of staff
6d there is appropriate specialist equipment and other resources to support teaching and learning	course documents equipment/resource lists access to and utilisation of learning resources plans for replacement and updating resources use of off-site facilities lesson observation the views of staff and students
6e specialist classrooms, laboratories and teaching areas are suitably and safely equipped	equipment/resource list lesson observation
6f students have access to appropriate learning resources and materials to assist their learning	handouts and other learning materials library and other learning resources to support specialist provision textbooks lesson observation
6g students have suitable access to appropriate information technology resources	information technology strategy resource lists including hardware and software access arrangements and the support available to students
6h specialist accommodation provides an appropriate setting for teaching and learning	accommodation strategy surveys of the use of rooms lesson observation quality of the learning environment
Cross-college/general provision	
6i general accommodation is suitable, is used effectively and is well-maintained	accommodation surveys surveys of the use of rooms observation of the suitability of accommodation

6j general facilities to support learning, including libraries and learning resource centres, are of an appropriate quality and readily accessible to students	financial allocations and the use of these arrangements for identifying and meeting curriculum needs the range of resources including books, journals and other materials and equipment the quality of the learning environment, including the amount and the use made of the space available to students access, including opening hours staffing levels views of students
6k common areas, including refectories and common rooms, meet the needs of students and staff	accommodation surveys direct observation the views of students and staff
6l students have access to recreational and sports facilities, where appropriate	accommodation surveys data on participation and use range of facilities including use of those off-site direct observation the views of staff and students
6m the college caters effectively for students from particular groups, including those with physical disabilities	policy statements and development plans access and support arrangements direct observation the views of staff and students
6n teaching and support staff have appropriate work areas and access to facilities to help them in their work	accommodation surveys direct observation the views of staff
7 Quality Assurance	
7a the college sets itself high standards and has arrangements for quality assurance which lead to measurable gains in performance	mission statement strategic plan data and performance indicators covering all aspects of the college's work the views of employers, students and other clients views expressed by external verifiers/examiners
7b quality assurance arrangements are understood and supported by staff and governors, and meet the requirements of examining, awarding and accrediting bodies, and the *Charter for Further Education*	policy statements and guidance documents, including the college's charter academic board papers, where appropriate moderator's/verifier's reports the views of staff and governors
7c the college is committed to continuous improvement	guidance on quality assurance documents produced through implementing

7d quality assurance procedures cover every aspect of the college's work, are rigorously applied and are continually reviewed	guidance on quality assurance operational plans, including departmental plans arrangements linking quality assurance to strategic planning governing body papers documents produced through implementing quality assurance procedures
7e performance indicators are clearly identified, effectively used and help to ensure that money is well spent	management information, its accessibility and use course reviews college analysis of performance against targets views of staff
7f the college's reporting arrangements include regular and rigorous self-assessment of its performance which identifies strengths and weaknesses, informs strategic planning and leads to continuous improvement	course reviews and other quality assurance reports student questionnaires liaison with employers and survey of employer's opinions the views of staff and students self-assessment report
7g the college's own charter is readily available and clearly identifies the standards of service which students and other customers can expect	arrangements for reviewing and monitoring charter commitments examination of the charter and its use the views of customers analysis of complaints
7h responsibilities for quality assurance arrangements arising out of links with other colleges, including franchise agreements and other forms of contracted provision, are clearly allocated, understood and met	policy documents and agreements review documents direct observation and the views of representatives of external colleges
7I staff appraisal and professional development are integral to quality assurance	appraisal documentation staff development policies staff development reports allocation of resources for staff development progress on appraisal
8 Management	
8a effective management enables the college to achieve its targets, to meet its other criteria for success, and to keep teaching and learning under constant review	mission statement strategic and operational plans data on the college's performance in all aspects of its work
8b the college's values and its aims, objectives, targets and criteria for success, as embodied in strategic and operating plans, are understood and supported by staff	strategic and operational plans Investors in People status arrangements to communicate aims and objectives to staff the views of staff

8c the college's management structure and its lines of communication and accountability are effective; staff understand their roles in the context of how the college is managed	documentation on the management structure arrangements for internal communications the views of managers, teachers and other staff minutes of management meetings and action plans
8d staff and other resources are effectively and efficiently deployed	organisation and management structures job descriptions and timetables the views of staff
8e there is appropriate and effective liaison with external bodies involved in education and training, for example training and enterprise councils, local education authorities, careers education and guidance services, schools and other organisations within the local community	documentation and evaluation of external links the views of representatives of external organisations
8f the college's strategic development is informed by effective market research	use of TEC and other labour market information market research and marketing plans responses to key national reports internal sources of information the views of representatives of external groups
8g information needs of management are identified and management information is effectively used at all levels	management information strategy and its implementation course reviews and documentation returns to the Council reports to governors the views of managers and staff
8h equality of opportunity is promoted and effectively managed	policy statements monitoring arrangements the views of staff and students publicity and marketing material lesson observation
9 Governance	

9a governors effectively oversee the college's strategic direction, regularly monitor the college's and their own performance, and secure the appointment, appraisal and development of senior staff	arrangements for assuring the quality of the college's provision, including self-assessment processes and actions to inform the strategic planning instruments of governance membership of the governing body clerking arrangements attendance records the structure and work of governing body committees governing body papers and minutes code of conduct and register of interests financial memoranda observation of governing body meetings the views of governors and staff communication with staff arrangements for the appointment, appraisal and development of senior staff

The Issue Is Quality of Education

HE Dr. Ali Fakhro
Ambassador of Bahrain
France

Without slipping into paranoia, I tend to believe, along with a few others, that many institutions of society, particularly the political, are against radical changes in the field of education. Their phobic fears of the possibility that the education institution may become outside the grip of traditional conservatism makes them continually and adamantly against any steps that will free schools, teachers and students from the oppressive dictates of the bureaucrats and the autocratic demands of the families.

Politicians and parents are alike in wanting docile, rule-abiding, conservative, non-critical children. Change brings the possibility of threatening revolt and change, therefore, must be avoided.

But quality education has its roots in a continuance of change of educational aims, strategies, contents and methods to cope, on one hand, with the huge ongoing worldwide political, economic, social and technological changes and to keep, on the other hand, pushing relentlessly for the ascension of mankind towards more justice, freedom and peace for all.

The conflict between the requirements of quality education and society at large is therefore a political and societal matter that needs to be addressed at those levels and at various arenas including this one of today.

With this background in mind, I would like to address the following issues that I consider of utmost importance for establishing the foundation for quality education and its continuous renewal:

1. Today the classroom is a place for passing information and, at times, knowledge from a teacher to a student. It is rarely a place, even in universities, of teaching and learning through intellectual, inquisitive and analytical dialogue, nor a place of creative thinking that utilizes perpetually the processes of criticism, dismantling and regrouping of concepts, values and outlooks for the sake of overpassing them to newer and more meaningful ones. Sadly, this deficiency is compounded by the lack of sufficient integration of basic taught concepts and facts which are needed by modern man when dealing with complex problems of life, production and complex services. The need for cultivation of the analytical power and creativity in the student that brings up a revolutionary being is especially becoming a matter of dire necessity now that we live in a so called modern age of communication and information. For it has been shown that advertising, news and entertainment that are put on television, radio and many other media facilities in brief and superficial messages are shortening and disfiguring the student's attention spans and retarding in-depth thinking within the classroom.

However, it is strange that although this type of progressive education was advocated by many in various forms such as child centred teaching, Ecole

Nouvelle, open classroom, etc., yet this whole approach has not taken enough strength to become a worldwide stream.

To me, the reason might be a simple but hidden one, since what we are advocating is not without a serious problem for a society not willing to accept the fruits of this drastic change. Would the society accept a student who would revolt against autocratic relationships within his family, non-democratic governments, injustices in the distribution of wealth in his community, lies of the media in the name of glorified history or armies or flags, and ossified religious institutions?

Finally, let me point out here that , when I speak of student challenging education, I am not advocating the ideology that speaks of "education for excellence" in the name of so called gifted students alone. I am depending here on established studies and experiences by Carroll and Bloom and others that have shown that the great majority of students can reach some of the highest attainments if given the necessary time and attention that they individually need.

2. The previous emphasis on the cultivation of the mind must not be understood to clash with, or even take priority over a balanced education. We are not for a feeble, non-spiritual, non-sensitive Socrates who is clumsy with football, Atari, Beethoven, Rock and Roll, love, fair competition, leaking kitchen pipes and who is inattentive to the calls of prayers and meditation.

But, we are for a cultivated mind that stands prominently at the centre of all experiences and activities of the students. I believe that without this uniquely nurtured mind even the most coherent reference system of higher values and life rules will be debased and misdirected by evil humans who unfortunately paraded throughout the history of mankind as great leaders. Only the central presence of the reasoning mind will make it possible that words will correspond with true meanings, titles with contents and that noble thoughts will be called so only if they lead to noble actions. Preparation of citizenry will not then be a preparation for blind loyalty.

3. The report to UNESCO of the international commission on education for the twenty-first century, lead by Jacques Delors, emphasised four pillars of education, namely learning to know, learning to do, learning to live with others, and learning to be.

I concur with that, provided that the basis of those pillars is formed by the concerns of the individual world of the student, his family and his immediate community.

But, do our curriculae pay enough attention to this simple condition? Except for the essential nature of learning the so called basics, especially of language and mathematics and scientific method, is there anything more important in the life of the student than his complex relationship with his parents, siblings and peers or his difficult emotional upheavals during the various stages of his development?

Does the student really care about subjects like geography or history before understanding the conflicts between the taboos of his society and his physiological and psychological and spiritual dictates?

Today the home of the student and his community are crowded by all types of technological by-products. Can't we teach a lot of science through full understanding of these by-products, thus truly reducing the technological alienation of most students?

And his surroundings, be it his family or his small community. Do we teach him to observe them with objectivity and fairness as he tries to understand the intricate relationships so that he may later practice his citizenship with the spirit of tolerance, cooperation and democracy on one hand and the spirit of intolerance of corruption, social injustice, social exclusion, and all variety of serfdom to the societal pseudo gods on the other hand?

The list is, of course, inexhaustible, but the point I am trying to emphasize is relevance, concretness and usefulness of the curriculum.

4. It is because of this that the school-based curriculum is a serious matter. For only the school which is very close to the student, his family and the local community, will appreciate these aspects of the individual student's life. But, if the school is to perform this function adequately, it must be looked at as equivalent to the "cell" of any living body. It has to be defined as a cell with a structure, constituents, functions, organization, internal and external relationships. It is to be defined in terms of health, illness and death.

The school needs to foster an environment that allows it to be vital and healthy. It needs to foster values that neutralize many of the negative ones of the surrounding community. It cannot teach students about democracy, tolerance, justice, co-operation, social cohesion, modernity and intellectual freedom if its daily practices negate those concepts. Like living cells it will not survive nor renew its vitality if it does not have the needed independence and the free dynamic interdependence with other education units.

To function as a living entity, every bit of it must be involved in its survival, its administration, its teachers and its students. No teacher and no student should ever be allowed to become aloof or passive. This, then will insure that the school will be a small co-operative, developing, dynamic community in which the majority of education decisions are taken.

This importance of the school is especially pertinent in the Arab world, where the family is patriarchal and the community is autocratic and many governments are totalitarian. If there is hope for training youngsters to believe and practice all aspects of human rights, then that hope is to be found within such schools.

5. Such schools, however, will not be possible to exist if professionalisation of teaching is not addressed as a most serious issue. I am of the firm belief that the practice of teaching has reached the stage to be considered as one of the respectable professions that includes such professions as medicine or law. Most of the criteria needed for making a certain practice a profession are well established in the field of education and the list can be completed by taking a few other political and organizational steps.

Time unfortunately will not allow us to go into the details of this very important subject, but for those interested, the literature is plentiful.

What would professionalisation lead to?

a) A broadly educated university graduate with an excellent background in liberal arts, linguistics, neurosciences, communication and the basic aspects of informatics, especially Computer Sciences and, in addition, in-depth learning of courses in education, psychology, sociology, and the subject matter that he will be teaching.

b) A 1–2 year period of practical training similar to the internship and residency training programme of doctors in hospitals.

c) A life long in-service training and/or university-based retraining and updating.

d) A rigorous code of admission into, practice of and expulsion from the profession by the professional body or organization.

e) A total involvement in the application of the curriculum to suit the local needs and the individual requirements, with the freedom of taking initiatives and the responsibility of accounting for all his practices. In other words, we are talking of a professional who stands as the most educated in the community and therefore as one of the few who determines the nature and the future of that community.

Only such people can bring about all the changes that we mentioned in the first part of this lecture. To speak of quality education is to speak of quality teaching and teachers.

6. Finally I would like to touch briefly on the subject of student evaluation. Our present systems of evaluation are mostly unfair, narrow in their scope, trivial in their details, not continuous, and far away from being formative. There cannot exist a co-operative and a formative evaluation, followed by a series of relearning and evaluation, until the highest attainment is reached.

Again the central role of a highly trained intellectual teacher in this system must be emphasized. For we are talking of a teaching-learning-evaluation system for a radical human enrichment and empowerment. Only liberal, responsible and committed teachers can perform such tasks. Professionalisation is, of course, only one answer to those rigorous requirements.

Ladies and Gentlemen:

I did not touch the most explosive and important subject that will have a penetrating effect on the education for the twenty-first century, i.e. the subject of the revolution of communication and informatics and its exceedingly important role to the future of education. I had my reasons.

I am convinced that, unless the issues that I brought up are faced squarely, the new technology of the informatic age will again be either abused or at best marginally used as was the case with many other educational technologies and modern facilities.

Ladies and Gentlemen:

When I was asked to speak today I had two choices: either deliver a purely technical scholastic speech, which has to depend on the work and findings of eminent educationalists, or deliver one that is a combination of personal conclusions and the art of politics. I have chosen the latter, for I prefer to play the role of the truthful innocent child who pointed to the naked emperor and to the amazement of the sheepish crowd asked: "But why is he parading naked?"

Yes, we need to dress up our parading emperor, the field of education, and arouse our cheated crowd, the parents and other citizens.

I thank you.

The Interaction between Technology and National Development: The Case of Japan, 1955–1995

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1. Introduction

Despite many handicaps, Japan achieved a rapid enhancement of its technology and productivity levels by focusing its efforts on improving the productivity of the relatively scarce resources (constrained production factors) in each respective era (1). Such remarkable improvement can be largely attributed to private industry's vigorous efforts to invest in R&D resulting in a rapid enhancement of technology contributing to improvement in industry productivity levels, leading to national development (Fig. 1). Improved productivity and the resulting national development induced further vigorous R&D which again resulted in further enhancement of technology, leading to the construction of a virtuous cycle (i.e. successful stimulation and induction interaction) between technology and national development (4). To date, a number of studies have identified the sources supporting Japanese industry's technological advancement and consequent national development (7, 26). Thus far, however, limited attention has been paid to an inducing mechanism, Japan's way of technological education, leading to the construction of such a virtuous cycle (62).

Similar to an ecosystem, Japan constructed an elaborate system between internal technology and external technology (47), which can be distinctly observed in the above virtuous cycle (57). This system, formulated by a combination of industry efforts and government stimulation, functioned quite well during the period of rapid economic growth of the 1950s and 1960s, and succeeding grave energy and environmental crises of the 1970s and early 1980s (39). MITI (Japan's Ministry of International Trade and Industry — responsible for industrial technology policy, in particular) stimulated and induced industry's efforts by establishing a sophisticated policy system which has strengthened dynamism conducive to technological development (37, 38). However, since the relaxation of energy constraints and the succeeding "bubble economy" (1987–1990) and its bursting (1991), Japanese industry has faced a structural stagnation of R&D activities (44, 49) which may result in the collapse of the above virtuous cycle (58).

Focusing on the perspective of such a metabolic aspect of technological development in a context of its interaction with national development, this paper analyses the source of the inducing mechanism, Japan's way of technological education, leading to the construction of the virtuous cycle between technology and national development. Section 2 demonstrates an empirical review of Japan's path and with respect to national development and technology's contribution to paving such a path. Section 3 attempts an empirical analysis of policy contribution and its mechanism. Section 4 briefly summarises some implications of an interaction between technological education and national development.

2. The Role of Technology: Japan's Path

Japan's success over the last four decades in achieving sustainable development can be attributed to an elaborate system between internal technology and external technology which can be distinctly observed in a virtuous cycle between technology and national development (4). This mechanism, can be decomposed into a complementary relationship between technology and capital, and technology substitution for scarce resources (constrained production factors) (57).

2.1 Complementary Relationship between Technology and Capital

The Japanese economy has shown tremendous growth due to the motivating influence of industrial development. Japan's world GDP share was 4.1% in 1960, 6.4% in 1970, and 9.1% in 1980. It increased to 14.8% in 1990 as illustrated in Fig. 2, and it is currently more than 18%. Such tremendous growth can be attributed largely to rapid technological progress as demonstrated in Fig. 3 (11).

Whereas agriculture, forestry, fisheries and mining generally stagnated in the post-war period, manufacturing industry took a leading role in stimulating Japan's economy as a whole as illustrated in Fig. 4 (36). The manufacturing industry displayed distinctive dynamism and initiative in shedding obsolete equipment, facilities and technology and venturing into new lines of activity, all of which rapidly enhanced technology and productivity levels (24). These efforts resulted in the attainment of levels outmatching other competitors and recognition as being among the world's most advanced nations (7).

Such remarkable improvement has mainly resulted from private industry's vigorous efforts to invest in R&D (Fig. 5). The marginal productivity of Japan's industry's capital investment has exceeded those levels found in the USA and European countries (67). In addition, the marginal productivity of its R&D investment (rate of return to R&D investment) has proven to be much higher than capital investment (61), and the internal rate of return to R&D investment has maintained an extremely high level in comparison to other advanced countries (20, 61).

This high level of rate of return to R&D investment in Japan's industry induced further efforts by private industry to increase R&D investment. It is important to note that these efforts were incorporated with capital investment (57, 67).

Thus, through the support of a complementary relationship between R&D and capital investment, Japan's manufacturing industry displayed distinctive dynamism and initiative in shedding obsolete equipment, facilities and technology, resulting in a rapid enhancement of its technology and productivity levels.

2.2 Technology Substitution for Constrained Production Factors

Despite many handicaps, Japan achieved a rapid enhancement of its technology and productivity of the relatively scarce resources (constrained production factors) in each respective era (10). This mechanism can be attributed to an elaborate system between internal technology and external technology (Fig. 6).

Internal technology focused to improve external technology by improving the productivity of the relatively scarce resources, and improved technology, in return, induced further internal technology. Although capital was a scarce resource up until the 1950s, with economic development, the scarce resources shifted to labour in the 1960s, environmental capacity from the mid-1960s to the start of the 1970s, energy following the first energy crisis in 1873 up until the early 1980s, and again labour after the relaxation of energy prices starting from 1983 as illustrated in Fig. 7. While many have attributed this achievement to the complementary relationship between R&D and capital investment, technology (which is a relatively constraint free production factor) in fact provided the strongest contribution through its substitution for scarce resources (constrained production factors).

Facing the energy crisis in the 1970s, despite damaging impacts due to the sharp increase in energy prices (Fig. 8), under the support of the above mechanism, Japan was able to maintain sustainable growth by shifting from an energy dependent mode to a "greener" mode as illustrated in Fig. 9. Fig. 10 illustrates trends in value added (GDP, production, energy consumption and CO_2 emissions) in Japan's manufacturing industry over the period 1955–1994. Looking at Fig. 10 we note that Japan's manufacturing industry achieved sustainable development over the last two decades while minimising energy dependency and CO_2 emissions, and that this was enabled largely by efforts to improve energy efficiency or decrease unit energy consumption. Such efforts were results of technology substitution for energy thereby Japan's manufacturing industry was able to overcome energy environmental constraints while maintaining sustainable development.

Thus, despite numerous handicaps, through the support of the complementary relationship between technology and capital and technology substitution for scarce resources, Japan's manufacturing industry displayed a distinctive dynamism and initiative in shedding obsolete equipment, facilities and technology, resulting in the rapid enhancement of its technology contributing to the improvement in its productivity levels. Improved productivity and the resulting increase in production induced further vigorous R&D which again resulted in further enhancement of technology. Through this mechanism, Japan constructed an elaborate virtuous cycle between technology and national development.

3. Policy Contribution and Its Mechanism

Over the last four decades, technology has played a significant role in Japan's achievement of sustainable development despite numerous handicaps. Among production factors, technology has identical characteristics, including intangible, uncertainty, huge risk, high cost, and a long lead-time. These characteristics contain two important implications. First, private industry generally flinches from challenging technological investment without certain favourable conditions. Second, technology can maximise its potential performance in a comprehensive organic socio-economic system.

With such implications, Japan's success in constructing an elaborate virtuous cycle between technology and economic development is considered to be attributed to a sophisticated combination of industry efforts and government stimulation. Government stimulation was focused on constructing an elaborate socio-economic system in which technology could maximise its potential performance. Such a system is not static. Rather it is dynamic, comprehensive and organic, corresponding to both domestic and international environments in each respective era.

3.1 Economic Environment and Social and Cultural Foundations

Fig. 11 illustrates trends in Japan's governmental support for R&D investment by industry. Looking at Fig. 11, we note that Japan's governmental R&D funding represented 5 to 10% of total industry R&D expenditures by the mid-1960s. As Japan's economy expanded, the relative level of government R&D funding decreased and currently, it is only 3%. Interestingly enough, Japan's governmental support for R&D investment by industry is extremely small compared to that of other advanced countries, as summarised in Table 1. Fig. 12 compares ratio of governmental R&D funding in advanced countries which indicates that the ratio of Japan's total governmental R&D funding is 1/5. Out of Japan's total governmental funding MITI's share for industrial R&D is only 1/8 as summarised in Table 2.

This observation implies the effectiveness of Japan's R&D policy system in stimulating industry R&D effectively when it has such limited financial resources. Despite a limited financial role, MITI has developed other methods and techniques which permit it to play a leading role in the stimulation of the industrial technology development process in a comprehensive organic system. This can be interpreted as "Japan's way of technological education." In order to elucidate this, a review of the factors which contributed to the rapid improvement of Japan's technology should be made.

Analysing the important contributing factors to the rapid improvement of Japan's high-technology products over the period when Japan enjoyed its 'high-technology miracle" (chiefly in the first half of the 1980s), the following factors can be pin-pointed:

a) Severe, but productively directed, competition. Domestic and international competition among industries as well as between producers and users is and has been very vigorous, but competition has tended to be productive, rather than destructive. Typical industries include *amorphous alloys, fine ceramics, and semi-conductor lasers.*

b) High quality needs of users and consumers. Producing high quality goods which meet and stimulate demand for high quality by end-users. Typical industries include *polymer separation membranes, advanced composite materials and digital private branch exchanges (D-PBX).*

c) Active inter-industry stimulation. This results from the far reaching influence of the development and application of related technologies, as well as the resulting stimulus to competition. Industries in which this can be clearly observed *include spectrum analysers, laser printers and charge coupled devices (CCD).*

d) Mutual stimulation between the dynamic changes in industrial structure and advancements in R&D. Most typically observed in this category are *particle accelerators, communication satellites and magnetic resonance imaging (MRI).*

e) Increased basic and original research thinking. Typically observed in this category are *microprocessors, bio-products, and super high-rise structures.*

f) The qualifications and attitudes of workers and high standards of quality control. For example, these can be seen in *semi-conductor memory devices and computers* among others.

g) Stimulation provided by national R&D projects. Included in this category are *laser processing machines, aircraft engines, and photovoltaic power generation equipment* among others.

On the basis of the above observations, it can be noted that there exists the following conditions which stimulate and induce industry's vigorous R&D efforts in Japan:

Economicenvironment:

- Severe but productively directed competition
- High quality needs of users and consumers (in terms of quality, function, design, etc.)
- Active inter-industry stimulation
- Mutual stimulation between the dynamic change in the industrial structure and advancements in R&D activities
- All of these conditions are based upon corresponding:
- Social and cultural foundations
- High levels of education
- Diligence and commitment of workers and managers
- Highly organised systems and customs
- Enlightened management strategy with dependence on government policy.

These economic environment and social and cultural foundations coincide with the factors which contributed to Japan's economic development after World War II as illustrated in Fig. 13. International factors functioned as a negative reaction against such grave situations as the energy crises and yen crises (the appreciation of Japan's yen), which inevitably distorted the favourable factors while domestic factors fostered the economic environment. Clearly, a high level of education is a fundamental requirement for a society with a competitive nature and which demands high quality goods. The commitment of workers and managers is a key element, without which very little could happen. Well organised systems and customs function in active inter-industry stimulation and respond to dynamic changes in industrial structure. Through the management strategies of firms, long-term considerations and long-term R&D investments are made which take into account structural change in industrial sectors.

Sources which enabled Japan's smooth and effective assimilation of technology import and active improvement of such imported technology can be attributed to the above socio-cultural systems as illustrated in Fig. 14.

3.2 Mechanism of MITI's Policy System

In line with the above mechanism, MITI has established a sophisticated policy system (Fig. 15) in its comprehensive industrial policy system. The basic principle of MITI's industrial policy system is to (i) promote free competition in the market place, (ii) stimulate the competitive nature of industry and (iii) induce the vitality of industry. In accordance with this principle, the basic approach encompasses (i) leading edge technology foresight (Fig. 16), (ii) close co-operation with related industrial policies as a policy web (Fig. 17) and dependence on an active and flexible approach, and (iii) best utilisation of innovative human resources at both national research laboratories and universities. Through such an approach MITI's industrial policy system, in co-ordination with other related industrial policies, aims at inducing a chain reaction of the vitality of industry by stimulating industry's potential desire for active R&D. Technology complementation with capital as well as substitution for constrained production factors such as labour, energy and environmental capacity can thus proceed. Such a stimulation process functioned particularly well against grave situations such as the energy and yen crises. Such crises acted as a spark which ignited leading to a chain reaction. The mechanism for such stimulation and inducement in MITI's policy system can be summarised as follows 39) (Fig. 18):

- Identification of future prospects for social and economic needs;
- Selection of strategic areas with high innovative potential;
- Formulation and publication of visions;
- Provision of policy measures, including formulation of a national R&D programme
- projects which induce industry to increase its R&D intensity;
- As the degree of R&D intensity increases, the potential for further technological challenge increases;
- Expectations for the outcome of technological development among industries increase;
- Inducement of further investment in R&D activities and
- Build up of dynamism conducive to technological development.

Among the above processes, identification of future prospects for social and economic needs and a corresponding flexible policy approach play key roles to enable policy to provide a timely ignition to an induction reaction to external shocks and crises and lead to a chain reaction. Indeed, Japan has adopted flexible industrial policies throughout its economic development, all of which reflect the international, natural, social, cultural and historical environment of the post-war period (36). In the late 1940s and 1950s, Japan made every effort to reconstruct its war-ravaged economy, laying the foundation for viable economic growth by introducing a "priority production system" which allocated limited raw materials, capital and foreign exchange for strategic industries, leading to the providing a solution which can simultaneously overcome energy and environmental constraints while maintaining sustainable growth (45). Identifying such a simultaneous solution was considered the only survival strategy for Japan as it faced crucial energy and environmental constraints.

Under these conditions, Japan's industrial technology programmes have reached a crucial point in which the following requests have been made (Fig. 20):

- Further intensive efforts related to basic and creative technology;
- Greater attention to developing science and technology that provide a solution for simultaneously overcoming energy and environmental constraints while maintaining sustainable growth; and
- A greater international contribution to innovative R&D and common critical global issues through the R&D process, its outcome and its ripple effect (16).

Although MITI has established a sophisticated policy system which has built up dynamism conducive to technological development, the policy system has been aimed at its own effectiveness and does not necessarily take into full account the redundancy of the broader system (26). In addition, it was primarily oriented to the rapid development and application of industrial technology for commercial use in the market place rather than for the accumulation of scientific, inventions and discoveries with a view to international contribution (Fig. 21).

Facing the above mentioned turning point, MITIs new task became the structuring of a new policy system which encourages forefront efforts in industrial technology to promote R&D on both basic technology and energy and environmental technologies so as to strengthen transnational independence (41).

In order to respond to such a global requirement in the 1990s, MITI decided to consolidate six existing national R&D programmes[2] into the following two comprehensive programmes in 1993 (55) (Fig. 22):

(i) The Industrial Science and Technology Frontier Programme

This programme entails restructuring the National R&D Programme (Large-scale Project: 1966), the R&D Programme on Basic Technologies for Future Industries (1981) and the R&D Programme on Medical and Welfare Equipment Technology (1976) by introducing:

a) Fundamental and creative R&D which will contribute to further development of the economy and society by building a new technology paradigm with a new concept, philosophy and approach and also by making technological breakthroughs, and
b) Mission-oriented R&D to attain the social goal of meeting public demand and a quality of life common to the international community, in addition to realising real human life (3).

(ii) The New Sunshine Programme

Based on the recognition of the two-sided nature of the global environment issue and energy consumption, this programme aims at a comprehensive approach for overcoming global energy and environmental constraints while maintaining sustainable growth through the integration of the Sunshine Projects (R&D on New Energy Technology: 1974), the Moonlight Project (R&D on Energy consolidation of the economic foundation and rationalisation of industrial productivity. During the decade of the 1960s, Japan actively sought to open its economy to foreign competition by liberalising trade and the flow of international capital. In the process, it achieved rapid economic growth led by the heavy and chemical industries. On the other hand, the heavy concentration of such highly material -intensive and energy-intensive industries led to serious environmental pollution problems (35). This necessitated a re-examination of industrial policy which led to a shift towards a knowledge-intensive industrial structure that would reduce the burden on the environment by depending less on energy and materials and more on technology (22). In the 1980s, intensive efforts continued for the attainment of greater creative knowledge (Table 3).

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[2] R&D programmes under a national initiative initiated by MITI's AIST since 1966.

Industrial technology policy initiated by MITI focused on inducing industry to respond to the above historical demands (37) (Table 4). Japan's success over the last four decades in constructing a virtuous cycle between technological development and national development in the face of numerous constraints can be attributed to such a dynamic and flexible policy approach corresponding to a dynamic change in domestic and international environments (10).

Through the above review, a systematic view of the mechanism for inducing the vitality of industry in Japan has been developed as illustrated in Fig. 19. In this comprehensive organic system we note that, on the basis of a strong economic environment and upon the corresponding social and cultural foundation, there exists a strong potential desire for active R&D similar to the oxygen rich atmosphere in a chemical reaction.

Given such a condition, the role of government policy is how to further motivate such a strong potential desire leading to a chain reaction of industry vitality similar to the role of a catalysis. Thus, a relatively small government financial contribution can maximise its effect.

3.3 Japan's Industrial Technology Programme at a Turning Point

MITIs sophisticated policy system functioned very well, particularly in inducing industry's vigorous R&D challenges in overcoming the crisis in the 1970s and electronics oriented high-technology development in the first half of the 1980s. In line with this path, the source of Japan's leading high technology has been steadily shifting from an imported base to an indigenous base (24). This policy system can be interpreted as "Japan's way of technological education."

A new stream of technological innovation which emerged in the late 1980s suggested that it was necessary to develop a "new technological education system." This implied not only build on existing technology, but also to initiate creative technological innovation which would induce broad new technologies based on new scientific inventions and discoveries, whose results could be used to resolve global problems (14, 31). At the same time, with economic growth and technological advancement, Japan was requested to make a significant contribution to the international community through the R&D process, its outcome and its ripple effects (24). Furthermore, confronting economic stagnation and mounting concern for future sustainable development due to malevolent CO2 emissions resulting from energy use, a new direction was sought to recognise the critical role technology must play in (I) revitalising the world's economy and (II)

Conservation Technology: 1978) and the Global Environment Technology Programme (1989) (18).

The reorganisation of AIST's (the Agency of Industrial Science and Technology of MITI) national research laboratories, which includes establishing the National Institute for Advanced Interdisciplinary Research and extensively reviewing policy programmes for stimulating industry R&D activities, is expected to maximise the effectiveness of such a restructuring (Fig. 27).

4. Implications for an Interaction between Technological Education and National Development

The remarkable development of the Japanese economy has been largely attributed to a virtuous cycle between technological development and national development. This cycle was enabled by an elaborate system between internal technology and external technology. Such an elaborate system, formulated by a combination of industry's efforts and government stimulation, functioned quite well. MITI's efforts focused on establishing a sophisticated policy system which stimulated and induced industry's efforts towards formulating the above elaborate system.

This policy system based on such basic principle as to(I) promote free competition in the market place, (ii) stimulate the competitive nature of industry, and (iii) induce the vitality of industry encompasses the following basic approach:

I. Leading-edge technology foresight,
II. Close co-operation with related industrial policies as a policy web and dependence on an active and flexible approach, and
III. Best utilisation of innovative human resources at both national research laboratories and universities.

This system can be interpreted as "Japan's way of technological education," and has important insight for an effective interaction between technological education and national development which seems to be worth while widely transferring to international society. MITI's intensive efforts to restructure its long lasting national R&D programmes are expected to appropriately meet national demands concerning Japan's industrial technology at a turning point, and such efforts also provides an important insight as a new approach to stimulate an interaction between technological education and national development at a turning point. However, since the relaxation of energy constraints, sharp appreciation of the yen and succeeding "bubble economy" and its bursting, Japanese industry has been facing a fear of the collapse of the above cycle.

Facing such circumstances, we should keep in mind the example of an ecosystem, which demonstrates that once a cycle begins to collapse and fall into a vicious (negative) cycle, remediation of the system becomes impossible. Similarly, as an ecosystem requires consistent efforts to improve quality for its own maintenance, so does the interaction between technology and surrounding social, economic and natural environments. Thus, prompt remediation of the current vicious cycle's signature is urgent.

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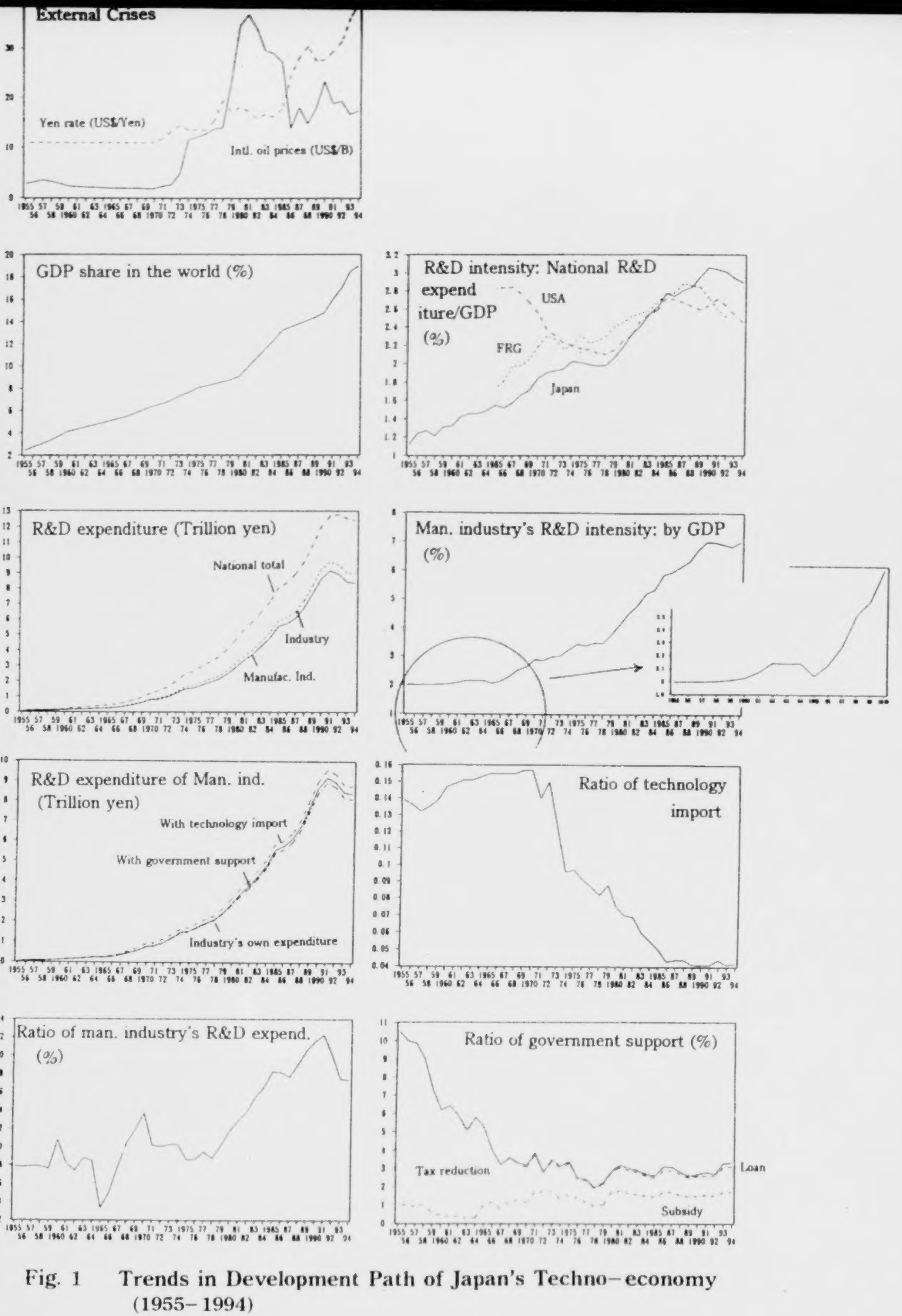


Fig. 1 Trends in Development Path of Japan's Techno-economy (1955-1994)

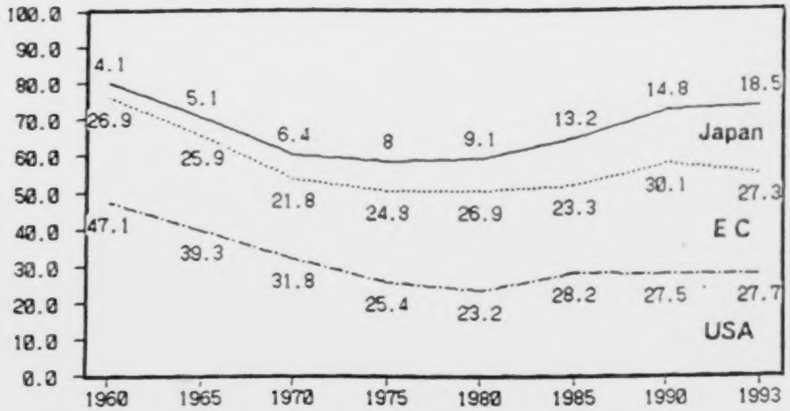
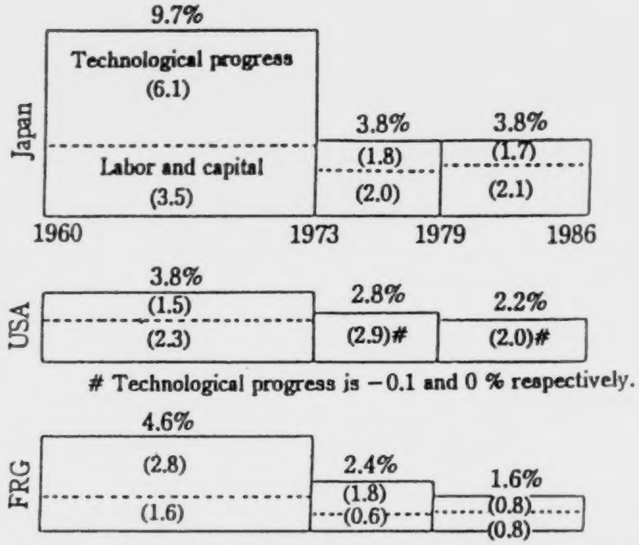


Fig. 2 Trends in GDP Share in the World (1955–1993) – %

Source: National Accounts (United Nations, Annual issues).



# Technological progress is −0.1 and 0 % respectively.

Fig. 3 Comparison of the Contribution of Technological Progress to Economic Growth in Japan, the USA and FRG (1960–1986)

Source: OECD Economic Studies (1988).

Contribution of technological progress is measured by Total Factor Productivity (TFP) by using the following equation:

$$Y = A e^{\lambda t} L^{\alpha} K^{\beta}$$

$$\ln Y = \ln A + \lambda t + \alpha \ln L + \beta \ln K$$

$$\frac{dY/dt}{Y} = \lambda + \alpha \frac{dL/dt}{L} + \beta \frac{dK/dt}{K}$$

Contribution by
TFP Labor Capital

where Y: production (value added), A: scale factor, λ : TFP, t: time trend, L: labor, K: capital, α 、β : elasticities of labor and capital respectively.

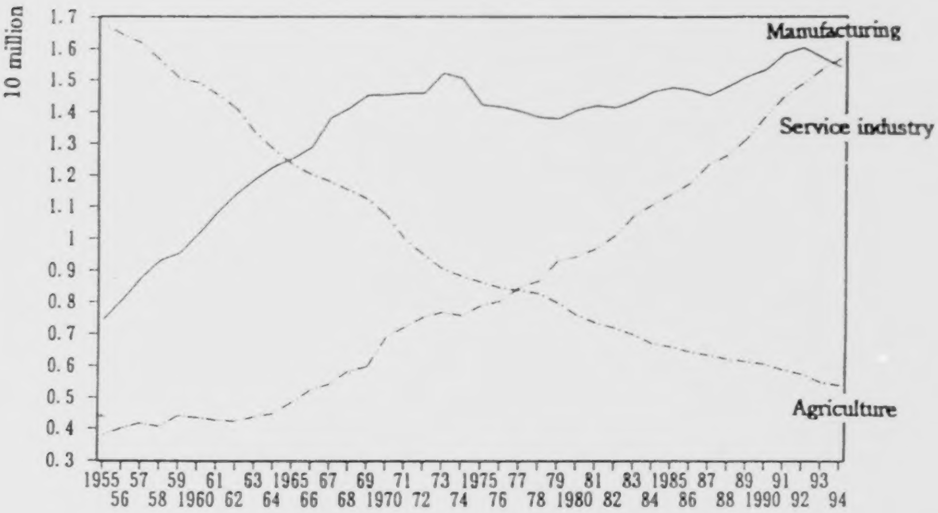


Fig. 4 Trends in Number of Employed Persons in Japan (1955– 1994) – 10 million

Source: Annual Report of National Accounts (Economic Planning Agency, Annual issues).

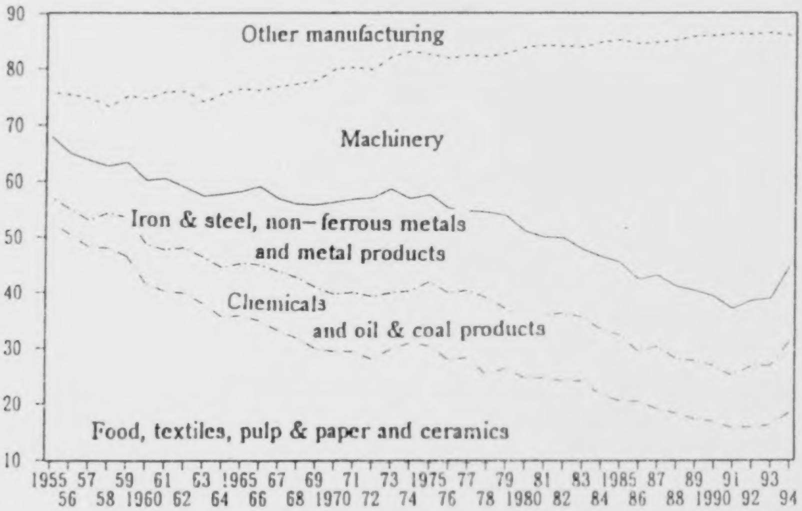
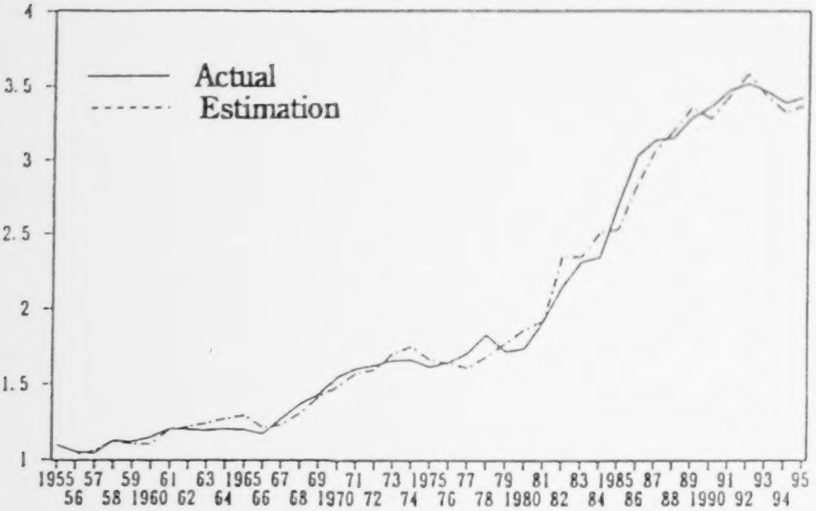


Fig. 4– 2 Trends in Industrial Structure in the Japanese Manufacturing Industry (1955– 1994) – value added share by 1985 fixed prices (%)

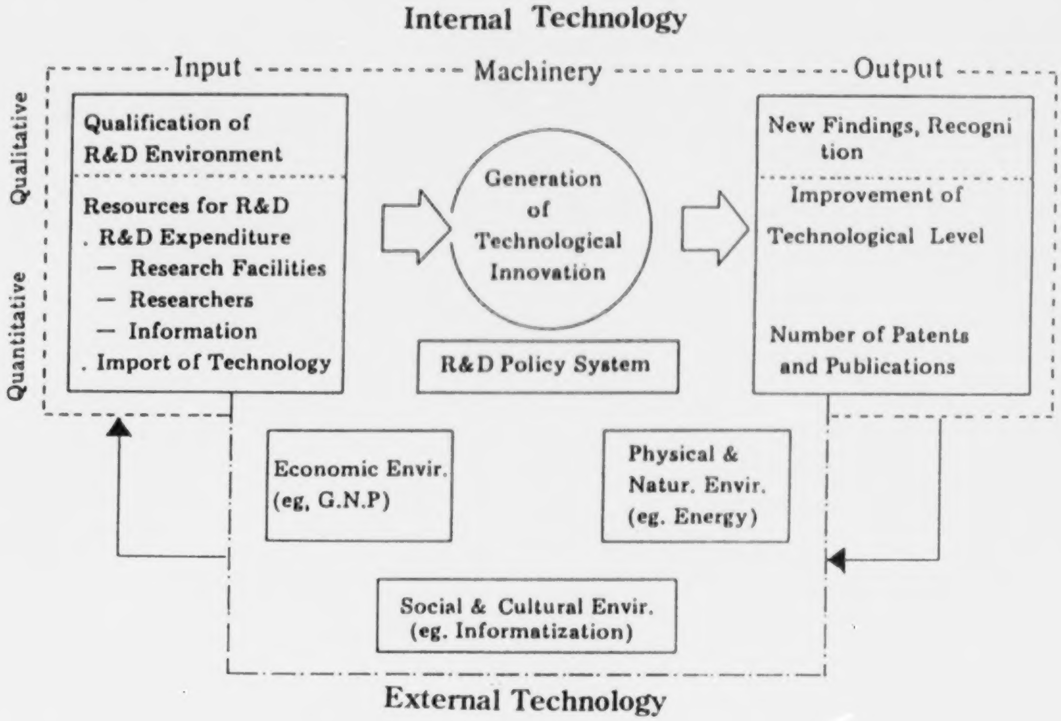
Source: Annual Report of National Accounts (Economic Planning Agency, Annual issues).



$$\ln R/S = 0.63 + \underset{(10.74)}{0.23} \ln(IRR_{-1}) + \underset{(8.98)}{0.27} \ln(Pe_{-1}) + \underset{(13.43)}{0.45} \ln (1/YR_{-1}) + \underset{(19.13)}{0.29} \ln (V_{-1}) \qquad \text{adj.R2 } 0.998 \qquad \text{DW } 1.27$$

R&D intensity — Internal rate of return to R&D investment — Prices of energy — Yen rate — Value added

Fig. 5 **Trends in R&D Intensity in the Japanese Manufacturing Industry (1955–1995)**


Internal Technology
Input
Machinery
Output
Qualitative
Quantitative
Qualification of R&D Environment
Resources for R&D
. R&D Expenditure
— Research Facilities
— Researchers
— Information
. Import of Technology
Generation of Technological Innovation
R&D Policy System
New Findings, Recognition
Improvement of Technological Level
Number of Patents and Publications
Economic Envir. (eg, G.N.P)
Physical & Natur. Envir. (eg. Energy)
Social & Cultural Envir. (eg. Informatization)
External Technology

Factors Composing External Technology

External Technology
- Economic Environment
  - . Market Conditions
  - . Quality, quantity and cost of Production Elements (Capital, Labor)
- Physical & Natural Environment
  - . Energy Resources
  - . Geographical Conditions
- Social and Cultural Environment
  - . Education
  - . Ethics of Labor and Entrepreneur
  - . Custom and tradition
  - . Preference of Consumer
- Policy System

Fig. 6 Mechanism of Technological Innovation – Interaction between Internal Technology and External Technology

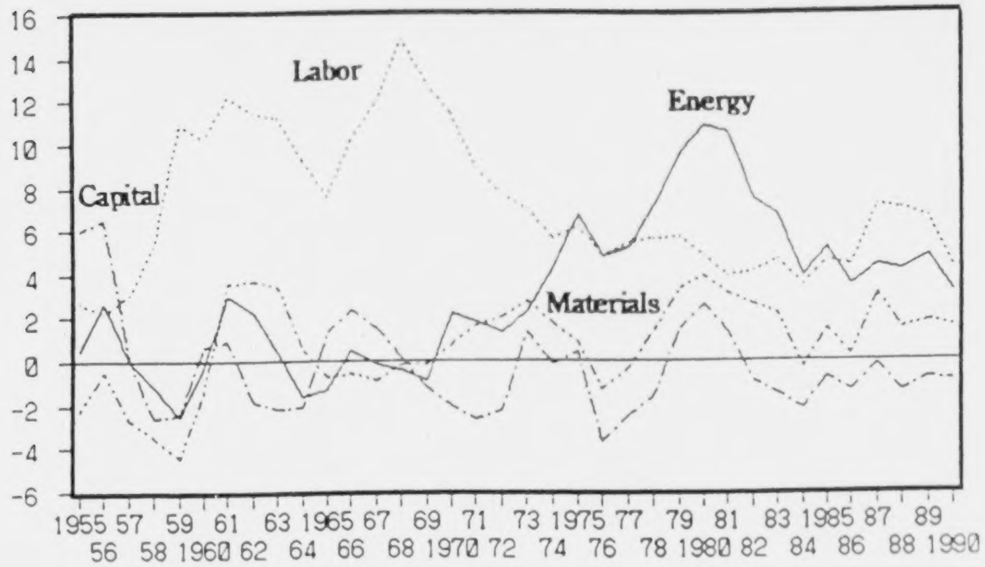


Fig. 7 **Trends in Change Rate of Productivity of Production Factors in the Japanese Manufacturing Industry (1955–1990) – 3 years' moving average (%)**

Productivity is measured by the ratio of value added and respective production factor.

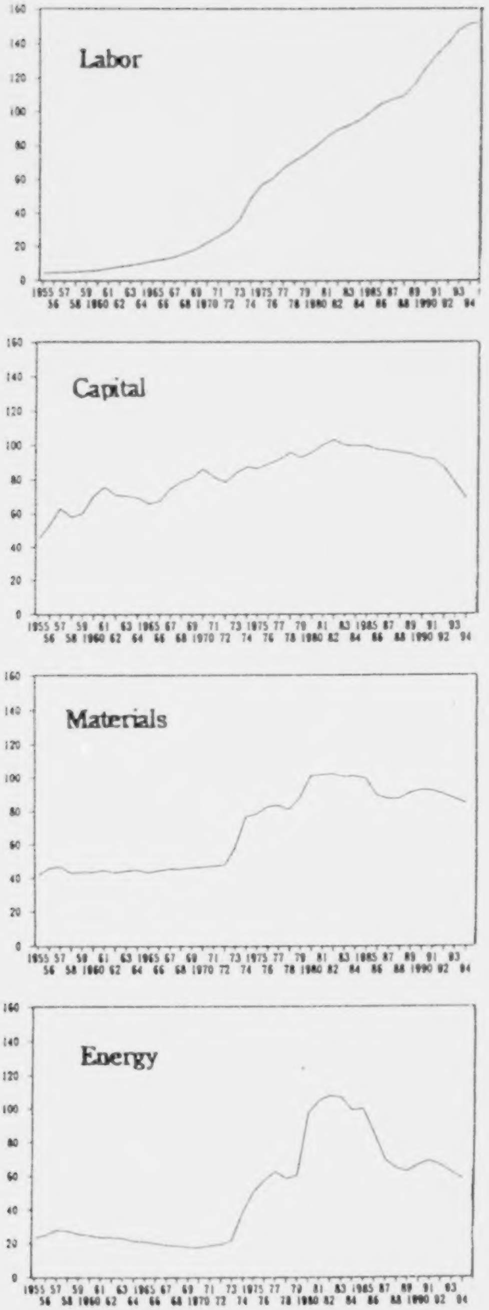


Fig. 8 **Trends in Prices of Production Factors in the Japanese Manufacturing Industry (1955–1994) – Index: 1985 = 100**

Prices are measured by the following equation:
Px = GXC/X, X: L, K, M, E

where Px: prices of production factor X, GXC: gross cost of production factor X, L: labor, K: capital, M: materials and E: energy.

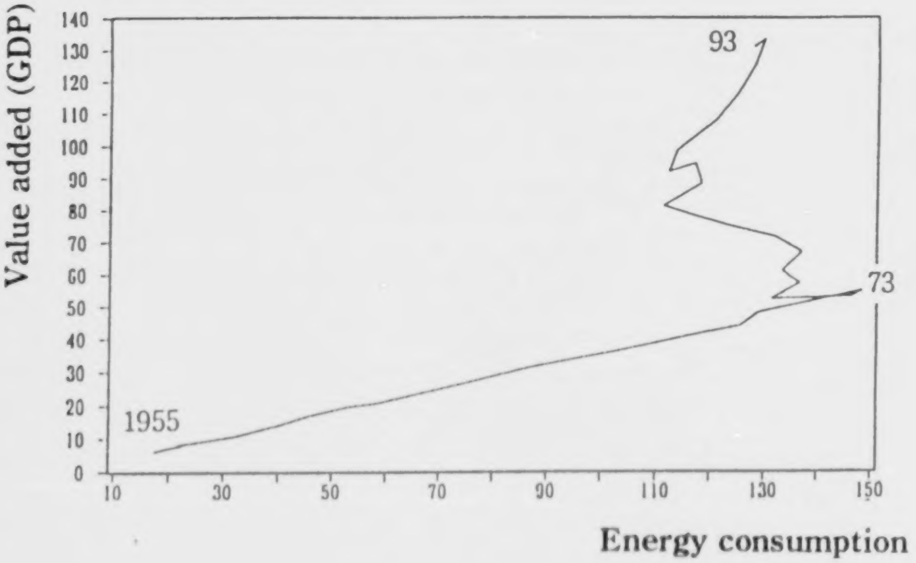


Fig. 9 Trends in a Shift from Energy Dependent Mode to Greener Mode in the Japanese Manufacturing Industry (1955–1993)

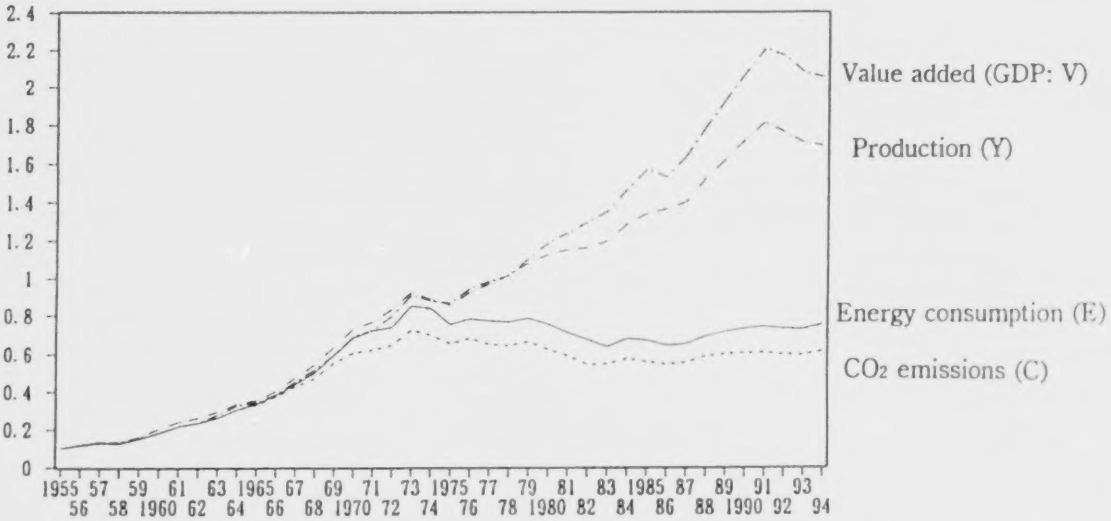


Fig. 10 Trends in Production, Energy Consumption and CO_2 Emissions in the Japanese Manufacturing Industry (1955–1993) – Index: 1955=1

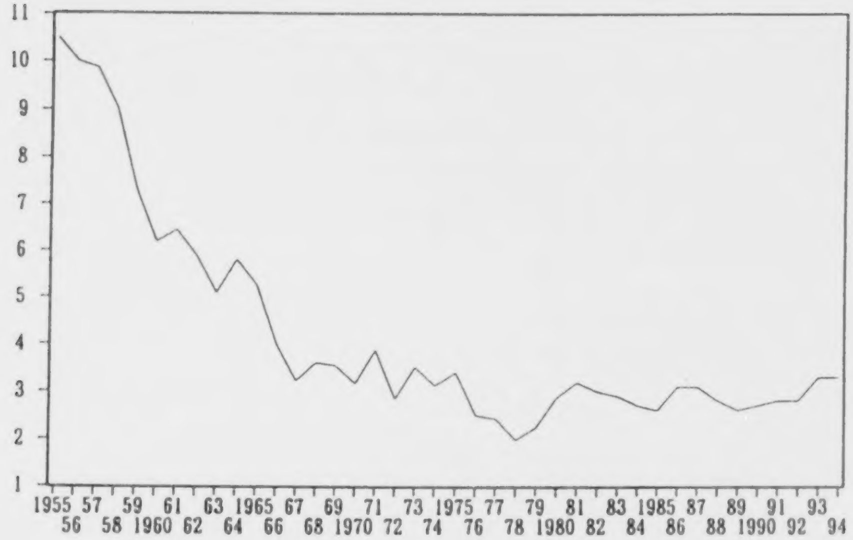


Fig. 11 **Trends in Japan's Governmental Support for R&D Investment by Industry (1955–1994) –%**

Ratio of government R&D funds in industry's R&D expenditure.
Sources: Wakasugi (1986), AIST of MITI and White Paper on Japanese Science and Technology (Science and Technology Agency: Annual issues).

Table 1 **Comparison of Government R&D Funds in Industry in Advanced Countries**

Japan (1994)	USA (1993)	Germany (1991)	France (1992)	UK (1993)
3.3	29.6	22.7	18.3	14.6

Ratio of government R&D funds in industry's R&D expenditure.
Source: White Paper on Japanese Science and Technology (Science and Technology Agency, 1995).

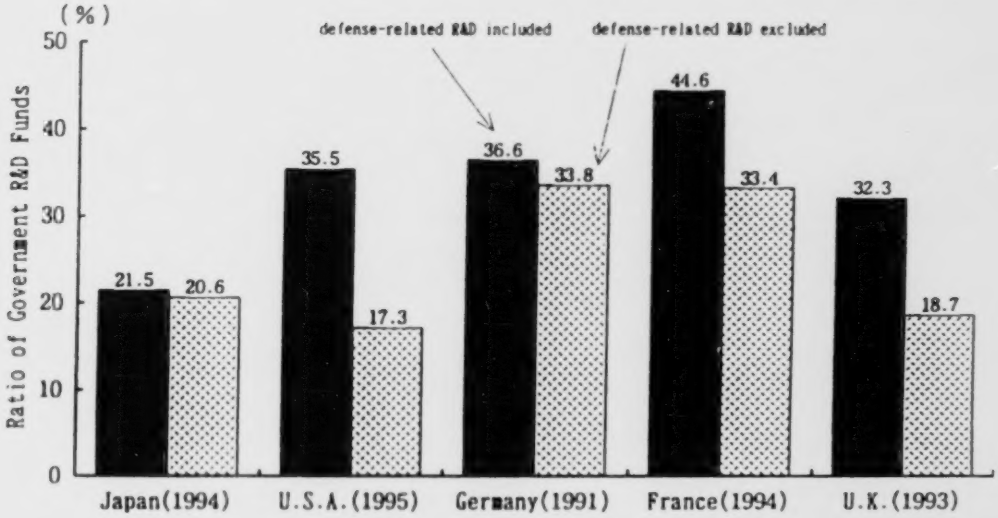


Fig. 12 Ratio of Government R&D Funds in Advanced Countries (Natural science and cultural & social sciences) – %

Note: Ratio of Government funds excluding defense-related R&D(%)=(Government R&D funds-Defense related R&D expenditures)/(R&D expenditures-Defense related R&D expenditures) × 100

·Values of U.S.A. are estimated

·Values of Germany and France are provisional value

Source: Japan Report on the Survey of Research and Development(Management and Coordination Agency)

U.S.A. NSF「NATIONAL PATTERNS OF R&D RESOURCES」

Budget of the U.S. Government:Special Analysis

Germany Statistical data of BMFT

France Project de Loi de Frances

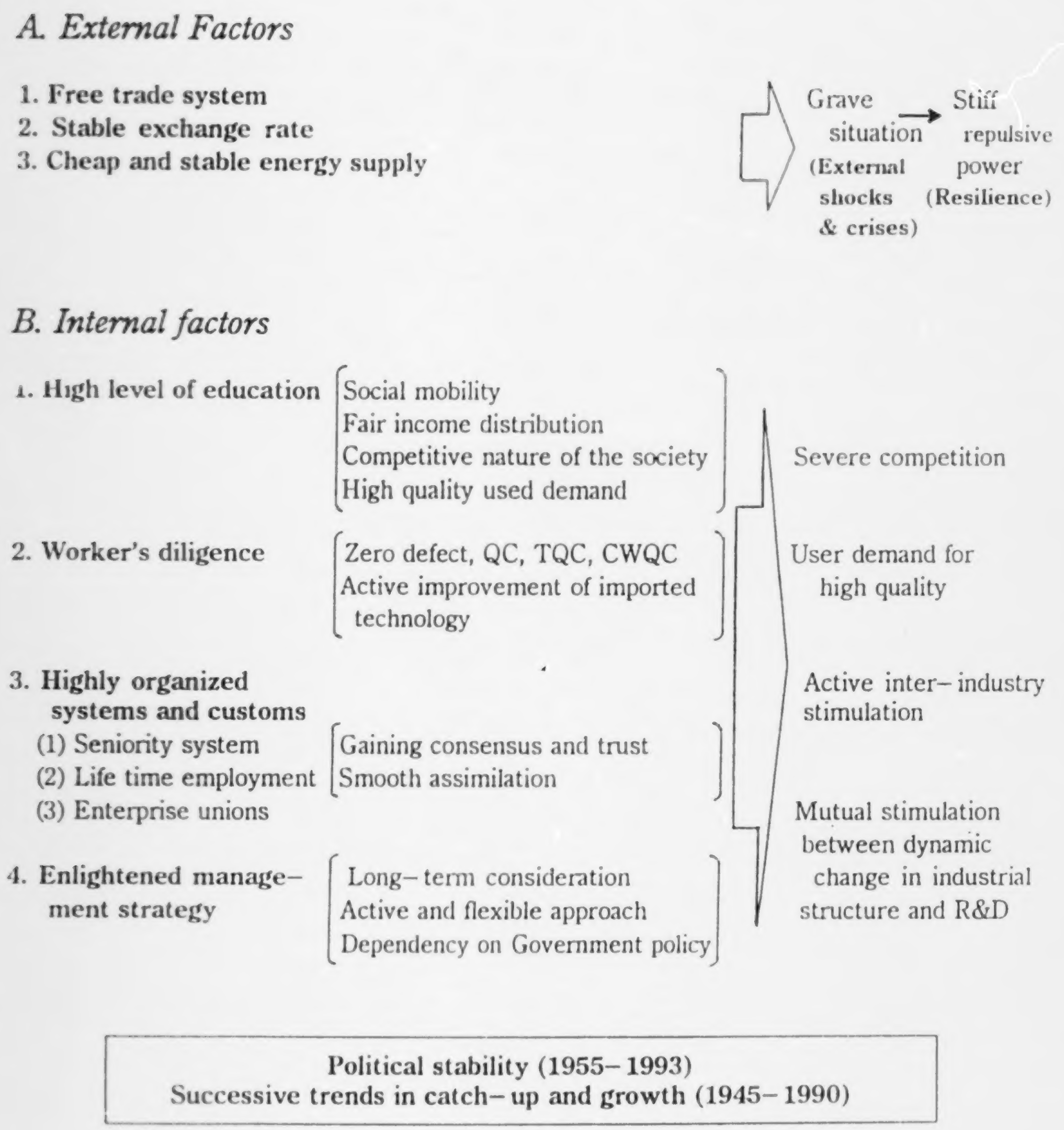
U.K. Forward Look 1995

Data are obtained from "White Paper on Science and Technology"

Table 2 Japan's R&D Expenditure in 1994 (billion yen = US $ 10 million)

	Total R&D	Government R&D		Ratio of government
Total	13, 596	2,918		21.5%
Natural science	12,419	2,358		19.0%
Min. of Education		1,100	46.7%	
STA		605	25.7%	
MITI		284	12.0%	
Other Ministries		369	15.6%	

Sources: White Paper on Japanese Science and Technology (Science and Technology Agency, 1996).
Report on the Survey of Research & Development (Management and Coordination Agency, 1995).



A. External Factors

1. **Free trade system**
2. **Stable exchange rate**
3. **Cheap and stable energy supply**

Grave situation (External shocks & crises) → Stiff repulsive power (Resilience)

B. Internal factors

1. **High level of education**
   - Social mobility
   - Fair income distribution
   - Competitive nature of the society
   - High quality used demand
2. **Worker's diligence**
   - Zero defect, QC, TQC, CWQC
   - Active improvement of imported technology
3. **Highly organized systems and customs**
   - (1) Seniority system
   - (2) Life time employment
   - (3) Enterprise unions
   - Gaining consensus and trust
   - Smooth assimilation
4. **Enlightened management strategy**
   - Long-term consideration
   - Active and flexible approach
   - Dependency on Government policy

Severe competition

User demand for high quality

Active inter-industry stimulation

Mutual stimulation between dynamic change in industrial structure and R&D

Political stability (1955-1993)
Successive trends in catch-up and growth (1945-1990)

Fig. 13 Foundation of Japan's Economic Development after World War II

1. Socio-cultural foundation cultivated through the Edo period (1603-1867)
    a. The homogeneousness of the nation
    b. High educational level
    c. Popularity of regional exchange of technology
    d. Activated information flow by means of "Sankin Kotai system"
    (the "Shogunate's system of periodic required attendance at Edo (now Tokyo) for Daimyo (federal lords))

- Cultural elasticity
- An indigenous ability to adopt and nationalize
- Pragmatism

2. **Flood of western civilization and culture** triggered by
    a. Unexpected call of the Kuro Fune (America's "black ships") in 1853
    b. Subsequent Meiji Revolution in 1868

3. **Japan's basic policy against the flood**
    Introduce and adopt a new civilization while basing its selection on
    a. Examination of traditional values, customs and institutions previously thought to have absolute value
    b. Objective appreciation of the excellence of western civilization and culture
    from the view-point of efficiency and a higher quality of life

4. **The Meiji Government's (1868-1912) policy**
    1) National targets and principle
        a. Wealth and military strength
        b. Increasing industrial production
        c. Japanese spirit and western learning
    2) Policies
        A. Cultivating Japanese spirit
            a. Educational system
            b. Moral ethics
        B. Western learning
            a. Translating western literature
            b. Employing advisers from western countries
            c. Constructing model factories
            d. Importing a package of advanced machinery systems
            e. Sending promising young Japanese youth to western countries to study

Introduction, adoption, assimilation and development of western technology selectively into the Japanese social and cultural system without spoiling the indigenous culture

- Technological developments in Japan before, during and after World War II was principally based on the above.
- Remarkable improvement in the high technology in the 1980s was considered as the crystallization of such historical efforts.

Fig. 14 Socio-cultural Systems Enabled Japan's Smooth and Effective Assimilation of Technology Import

Basic Principle

- Activate Free Competition in the Marketplace
- Stimulate the Competitive Nature of Industry
- Induce the Vitality of Industry

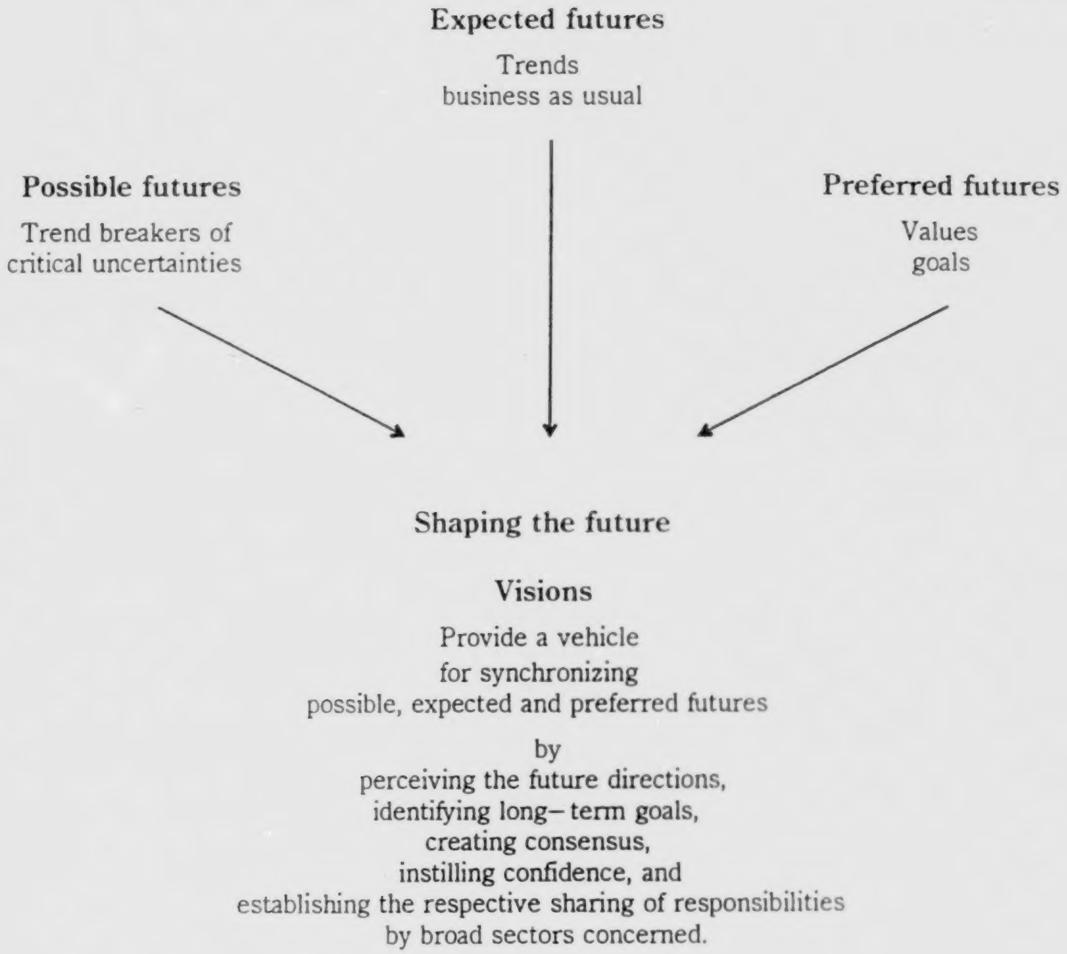
Approach

- Leading-edge Technology Foresight
- Maintain Close Cooperation with Related Industrial Policies
- Depend on an Active and Flexible Approach
- Best Utilize Innovative Human Resources in National Research Laboratories. and Universities.
- Organize Tie-ups between Industries, Universities and Government

Policy Formation/Implementation

- Vision Penetration, Identification, Providing Direction, Instilling Confidence, Developing General Consensus
- Action
  - Incentive: National Research Laboratory, R&D Program, Investment, Conditional Loans, Financing, Tax Exemption
  - Stimulation: R&D Consortium, Publication, Open Tender
  - Regulation: IPR, Monopoly, Accounting
- Dissemination Diffusion, Transfer, Demonstration, Public Procurement

Fig. 15 Basic Scheme of MITI's Industrial Technology Policy


Expected futures
Trends
business as usual
Possible futures
Trend breakers of
critical uncertainties
Preferred futures
Values
goals
Shaping the future
Visions

Provide a vehicle
for synchronizing
possible, expected and preferred futures
by
perceiving the future directions,
identifying long-term goals,
creating consensus,
instilling confidence, and
establishing the respective sharing of responsibilities
by broad sectors concerned.

Fig. 16 The Role of Visions – The Soft Technology of Public Administration

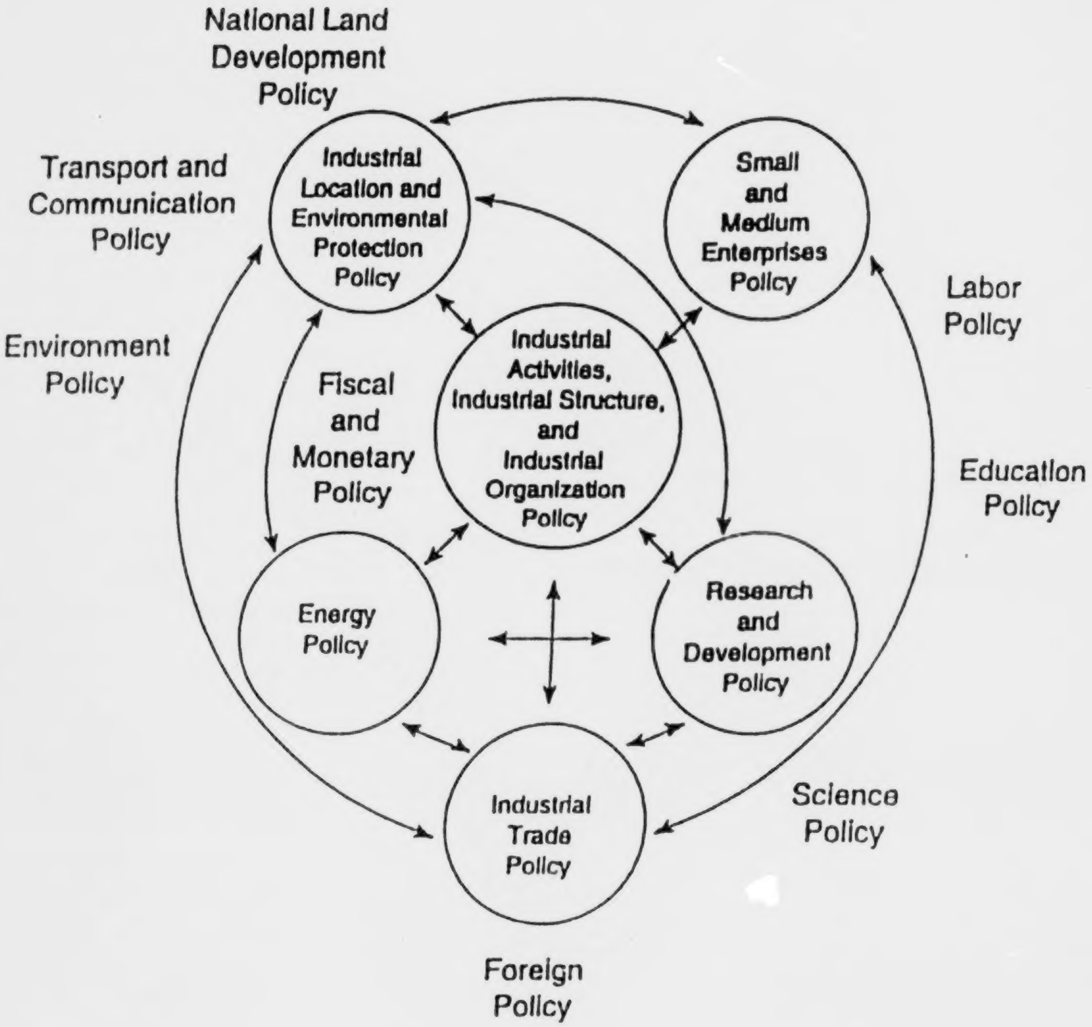

National Land Development Policy
Transport and Communication Policy
Industrial Location and Environmental Protection Policy
Small and Medium Enterprises Policy
Labor Policy
Environment Policy
Fiscal and Monetary Policy
Industrial Activities, Industrial Structure, and Industrial Organization Policy
Education Policy
Energy Policy
Research and Development Policy
Industrial Trade Policy
Science Policy
Foreign Policy

Fig. 17 Relationship of Major Industrial Policies

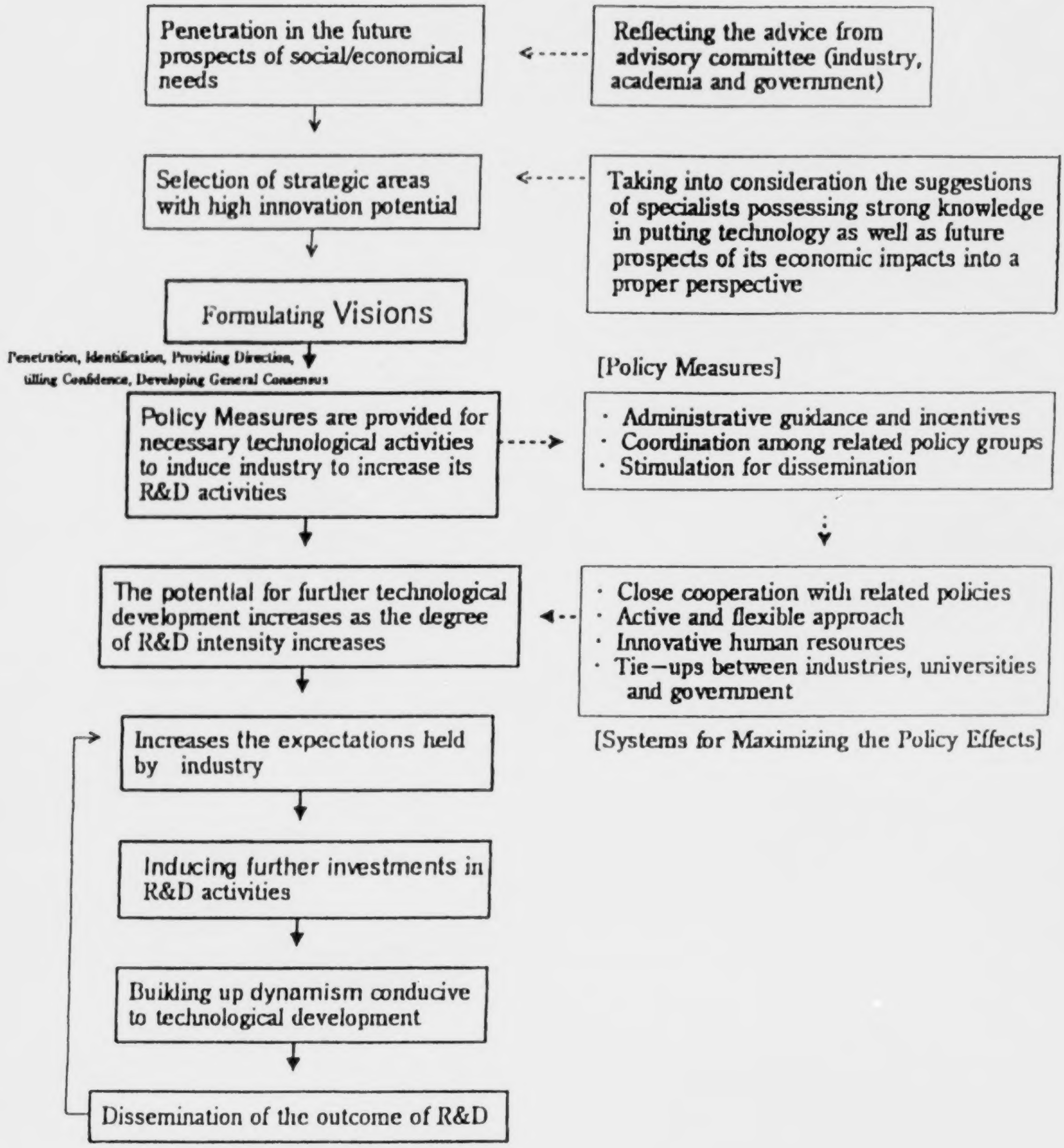

Penetration in the future prospects of social/economical needs
Reflecting the advice from advisory committee (industry, academia and government)
Selection of strategic areas with high innovation potential
Taking into consideration the suggestions of specialists possessing strong knowledge in putting technology as well as future prospects of its economic impacts into a proper perspective
Formulating Visions
Penetration, Identification, Providing Direction, tilling Confidence, Developing General Consensus
[Policy Measures]
Policy Measures are provided for necessary technological activities to induce industry to increase its R&D activities
· Administrative guidance and incentives
· Coordination among related policy groups
· Stimulation for dissemination
The potential for further technological development increases as the degree of R&D intensity increases
· Close cooperation with related policies
· Active and flexible approach
· Innovative human resources
· Tie−ups between industries, universities and government
[Systems for Maximizing the Policy Effects]
Increases the expectations held by industry
Inducing further investments in R&D activities
Building up dynamism conducive to technological development
Dissemination of the outcome of R&D

Fig. 18 Mechanism of the Total System of MITI's Industrial Technology Policy

Table 3 Trends in Japan's Industrial Structure Policy in the Post–War Era

1950s	Priority production system
1960s	Heavy and chemical industrial structure
1970s	Knowledge–intensive industrial structure
1980s	Creative knowledge–intensive industrial structure
1990s	Creation of human–values in the global age

Table 4 Chronology of MITI Initiated R&D Programs

1966–	The National R&D Program (Large–Scale Project)	Leading technology (big, risky)
1974–	R&D on New Energy Technology (The Sunshine Project))	Oil–substituting energy technology (renewable energy and energy conversion)
1976–79	VLSI Project (Very large scale integrated circuit)	Innovative computer technology
1976–	R&D on Medical & Welfare Equipment Technology	Medical and welfare technology
1978–	R&D on Energy Conservation Technology (The Moonlight Project)	Technologies for improving energy productivity
1981–	The R&D Program on Basic Technologies for Future Industries ("Jisedai" Project)	Basic and fundamental technology
1982–91	Fifth Generation Computer Project	Innovative computer technology (concept/system)
1985–	The Comprehensive Promotion of Private–sector R&D in Fundamental Technology (Key Technology Center Project)	Fundamental technology initiated by private-sector
1989–	The Designated Research Frame in the Global Environmental Field	Basic technology for global environment
1990–	The R&D Program for Global Environmental Industrial Technology	Global environmental technology

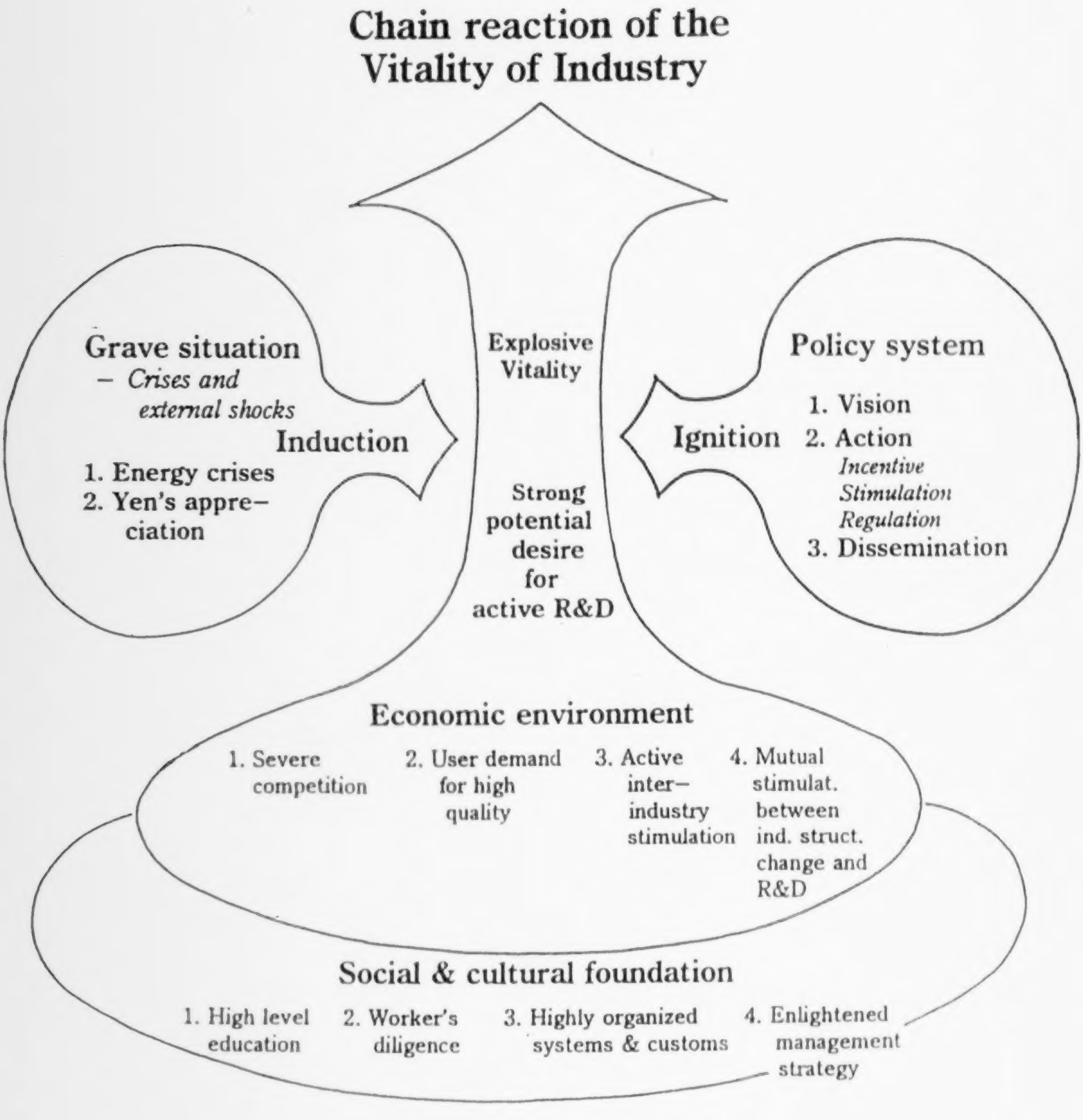

Chain reaction of the Vitality of Industry
Grave situation
– Crises and external shocks
Induction
1. Energy crises
2. Yen's appreciation
Explosive Vitality
Strong potential desire for active R&D
Policy system
1. Vision
2. Action
Incentive
Stimulation
Regulation
3. Dissemination
Ignition
Economic environment
1. Severe competition
2. User demand for high quality
3. Active inter-industry stimulation
4. Mutual stimulat. between ind. struct. change and R&D
Social & cultural foundation
1. High level education
2. Worker's diligence
3. Highly organized systems & customs
4. Enlightened management strategy

Fig. 19 Scheme of the Mechanism for Inducing Industry's Vigorous R&D Activities in Japan

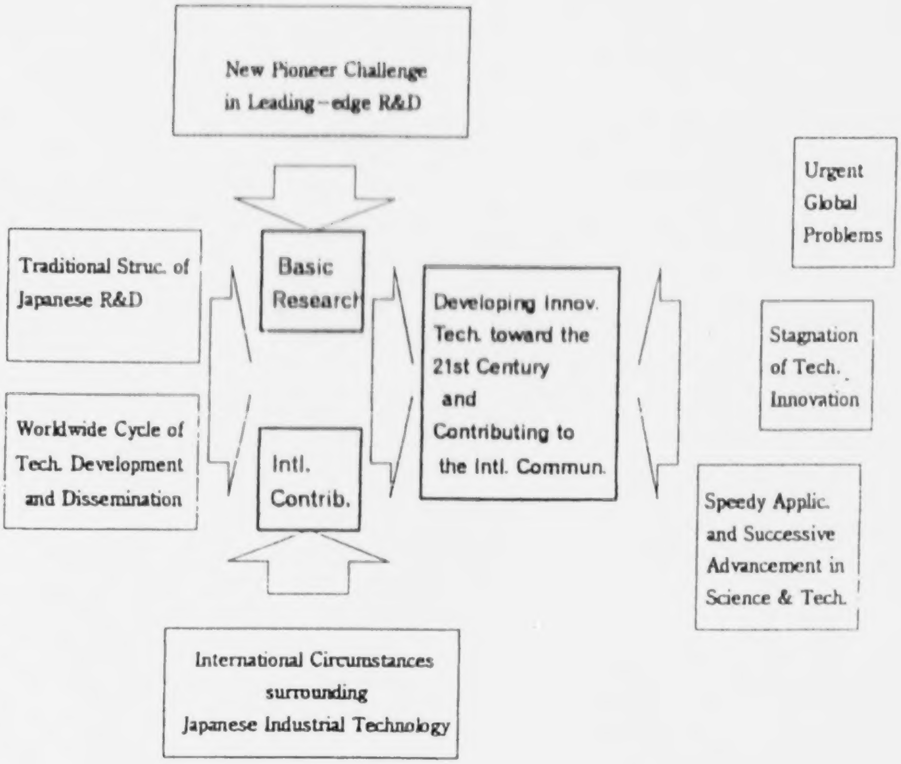

New Pioneer Challenge in Leading-edge R&D
Traditional Struc. of Japanese R&D
Worldwide Cycle of Tech. Development and Dissemination
Basic Research
Intl. Contrib.
Developing Innov. Tech. toward the 21st Century and Contributing to the Intl. Commun.
Urgent Global Problems
Stagnation of Tech. Innovation
Speedy Applic. and Successive Advancement in Science & Tech.
International Circumstances surrounding Japanese Industrial Technology

Fig. 20 Trends and Future Tasks in Japanese Industrial Technology at a Turning Point in the Late 1980s

	U K	W. Germany	USA	JAPAN
1. Introduction of overseas science and technology	17c	end of 18c	start of 20c	end of 1940's
2. R/D focusing on areas of application and development	start of 18c	start of 19c	1910's	1960's
3. Development of technology and industry	middle of 18c	middle of 19c	1920's	1970's
4. Accumulation of scientific findings	later part of 18c	end of 19c	1930's	1990's
5. Transfer of findings to other countries	end of 18c	start of 20c	1940's	end of 20c and start of 21c

Fig. 21 World-wide Cycle of Technological Development and Dissemination

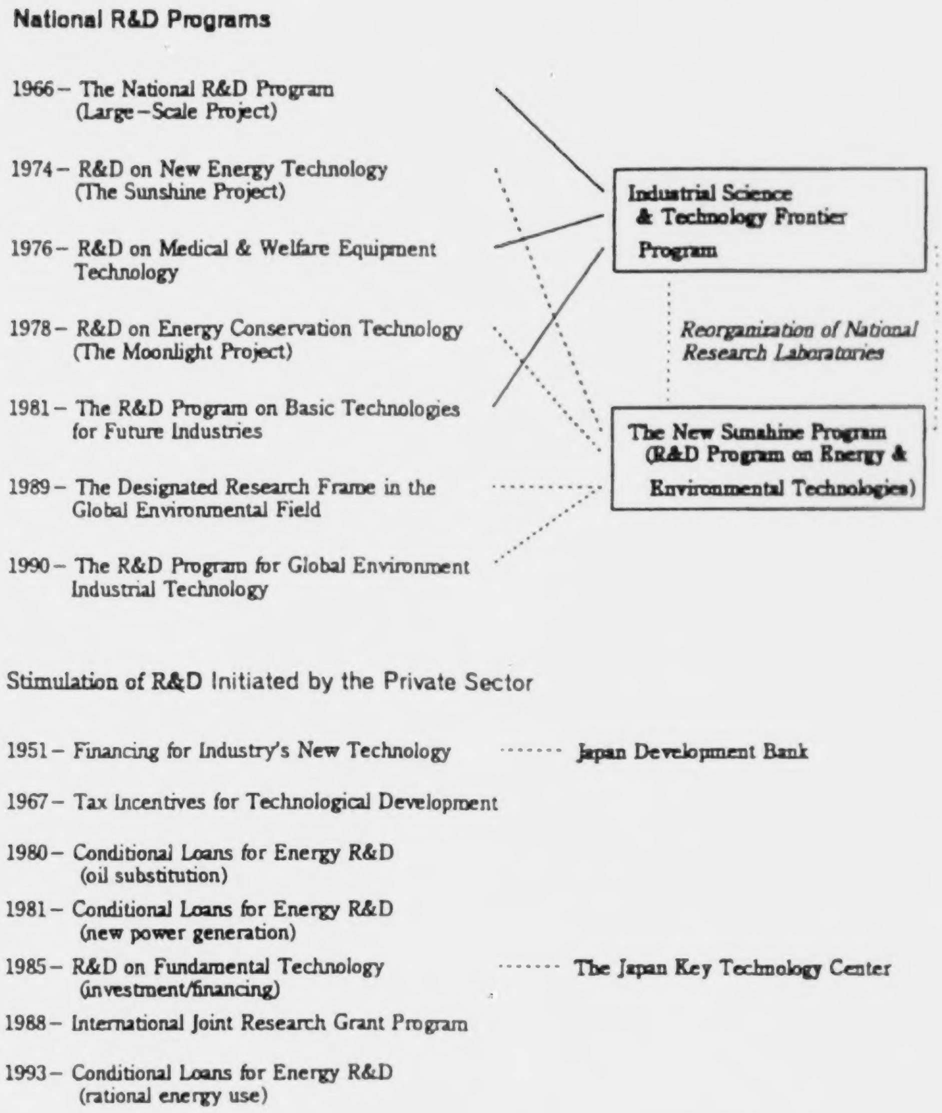

National R&D Programs
1966 – The National R&D Program (Large-Scale Project)
1974 – R&D on New Energy Technology (The Sunshine Project)
1976 – R&D on Medical & Welfare Equipment Technology
1978 – R&D on Energy Conservation Technology (The Moonlight Project)
1981 – The R&D Program on Basic Technologies for Future Industries
1989 – The Designated Research Frame in the Global Environmental Field
1990 – The R&D Program for Global Environment Industrial Technology
Industrial Science & Technology Frontier Program
Reorganization of National Research Laboratories
The New Sunshine Program (R&D Program on Energy & Environmental Technologies)
Stimulation of R&D Initiated by the Private Sector
1951 – Financing for Industry's New Technology
Japan Development Bank
1967 – Tax Incentives for Technological Development
1980 – Conditional Loans for Energy R&D (oil substitution)
1981 – Conditional Loans for Energy R&D (new power generation)
1985 – R&D on Fundamental Technology (investment/financing)
The Japan Key Technology Center
1988 – International Joint Research Grant Program
1993 – Conditional Loans for Energy R&D (rational energy use)

Fig. 22 Scheme of Restructuring of National R&D Programs

Meeting the Work Force Demands of the Future

Mr. Jack Tymann
Vice President
International Business Development
CBS, USA

Your excellencies, fellow delegates and distinguished businessmen.

The theme of our session this morning is the investment in human capital necessary to meet the work force requirements of the twenty-first century. Others on this panel, and throughout this conference, are addressing this issue from the perspective of government and the academic community. I will address the need for local, trained human resources from the perspective of a foreign firm — a firm like my own, looking to invest here and expand our business. Happily, up front, I can assure you that from all perspectives, we all agree that the only sustainable competitive advantage of a nation, or of a company, lies in the capabilities of its people.

Decades ago, it took a great deal of time, money, energy and effort and even legislation for a foreign firm to set up factories in markets outside its own land. Back then the transfer of capital, technology, information and transfer of required physical resources were monumental tasks. But today, in the age of satellite communications and the world wide web, capital, technology and information flow across boarders instantaneously. Even physical resources are transportable in very short periods of time.

The only asset that is not easily relocated is the skilled work force. Any foreign company that believes it can sustain a competitive advantage on a foreign soil, based on its technology of its products, is really quite wrong. For technology and project leads are very fragile and all a competitor has to do is beat your investment at a later time and it could over take you. A company and similarly a nation with the most skilled local work force are impossible to beat. All companies, including my own, are constantly searching for new growth opportunities. That can mean we develop new products or we increase market shares where we are or we go into new markets or some combination of these strategies.

For our purposes today, I am going to focus on new markets as the idea of growth and the question is: to what markets do companies like mine come? Where do we go and why do we go there ?

Why do we invest heavily in certain developing markets and yet we avoid other markets that have high potential? Quite simply, we go where we see a good fit between our own strengths and our own people and between the strengths of a region and the strength of their people. We go where our products and our technology can be adapted and assimilated into the local society. We go where a combination of all these strengths and the strength of our local partners give us sustainable competitive advantage.

As we look for choices of which markets to go for, we look to three things:

- The predictability and stability of the region.
- The size of the region.
- The availability of a locally skilled work force

First, the environment itself must be friendly. There must be open markets to us and it must be a stable and a predictable market. Secondly, when I talk about the size of the market, the market scale, we mean either within a nation, or regionally exportable from that nation. Thirdly, when we talk about human resources, we need local people to whom we can transfer our technology and our know-how, to assure that our investment will be sustainable long term.

Simply summarised, we go to global markets where we can apply our products in technology and know-how, in ventures that can be profitable for the long term. Today, as we approach the twenty-first century, we look to several high potential markets which are competing for the capital dollars that are available around the world. The markets that we are looking at include China, India, South East Asia, the former Soviet Union, Latin America and, of course, the Middle East and North Africa. We compare these markets, the openness of market reforms, the stability of the governments, the market scale that can be achieved through regional co-operation and the human capital available in each region, to manage and to implement our ventures locally. This last element is the one that brings us together today. The availability of skilled human capital.

We at CBS and other multi-nationals know that our international ventures can only be profitable and sustainable if they are competitive. That demands local talent, properly trained local professionals, who will stay with and grow with our ventures. Just as local human capital is critical to our co-operation, it is equally important to a nation in order to attract the foreign industrial partnerships that are critical to economic integration. This requires a national commitment to education, to higher education, to the right kinds of education. The largest educational gap in the developing world and the developing markets, is in trained and experienced professionals in fields such as basic management, marketing and business development. This is not a technology gap but a gap between the basic education and technology education and the real world experience in the global market place.

The transfer of our technology requires a local work-force trained sufficiently to assimilate and manage what we are trying to transfer here. This gap is being well addressed here in the UAE by the HCT, by CERT and by this conference. The market predictability and market scale, the other factors we look at are not the subject of this conference. I would like to discuss each briefly, as they apply to the Middle East, because it would be absolutely criminal to develop human capital here, human professional resources and create expectations of career opportunities for these young people and then have these people left outside the starting gate of the twenty-first century, in the global market place.

I believe market stability and predictability comes automatically with market scale and economic growth. It comes with inter-dependence of nations of a region. That is how peace is ultimately secured. To achieve this scale in the Middle East, the UAE and the rest the Middle East nations must quickly come to realise that the individual nations of this region simply lack the market scale of other developing markets like India, China, South East Asia and even the former Soviet Union. The only way to achieve market scale is through transnational regional alliances and through the economic mergers of the almost two dozen nations of the Middle East and North Africa - none of which, by itself, is a market large enough to attract significant foreign investment.

The Middle East nations, each lacking the economies of scale to go at it alone, must quickly decide to combine their markets somehow in this historic time of opportunity. The Middle East nations need to forge such regional economic alliances, or remain small fractionalised national markets.

The UAE can play a key role in this regard, much as Singapore and Malaysia played in leading the South East Asian nations into the ASEAN Pact. As Mexico and Chile are playing key roles in the integration of the Latin American markets, the Middle East must continue to move towards the vision of economic, regional collaboration, even in the face of continuing and renewed tensions on political front.

The Middle East must tell the world that it is moving forward, not backwards on the politics of peace, the stability of peace, the economics of peace. These are all parallel and interdependent processes. Political peace will bring scale and stability to the region. Scale and stability will bring investment. Investment will bring know-how to the people of the region and the people will bring long term sustainable economic growth and prosperity.

The public sector will ultimately secure the peace. The public sector will create market scale. The public sector will create interdependence among the people of the region in profitable business ventures. In this way the peace process, you can consider, will be privatised and secured.

The leaders of this region must create the right environment for this to happen, not only for themselves but for their children and their grandchildren. The key to this environment is higher education, such as the focus of this conference, and the focus of the UAE. The leaders of this region must continue to take these kinds of actions to ensure that their children's and their grandchildren's lives, will be different in the next century — better, safer, with more career opportunity and more prosperity than what has been the situation for much of this region in the last half of the twentieth century.

Conferences such as this one tell the rest of the world that the UAE, the Gulf, the rest of the Middle East and North Africa are opening, or are already open for business - that there exists a focus on education; that there exists high growth potential and a focus on excellency and human resources; that there is an open market here backed by the will of the leaders. They also tell the world that the young people of this region are ready to be unleashed towards sustainable economic prosperity by way of international partnerships and joint investment.

Conferences like this one focus on the young people and on the common goals that can unite this region, rather than on the differences that have divided it and still threaten its major market potential in the twenty-first century. Conferences like this one tell the world that the leaders of this region will no longer sacrifice economic growth and the futures of their children's and their grandchildren's careers to political differences. Conferences like this one focus on tomorrow's opportunities for success rather than on yesterday's failures. They focus on the prosperity possible at the end of the road rather than road blocks, which, in the past, prevented economic collaboration. Finally, conferences like this focus on broader education and integration of the people of this region into a New World order and a better life for the children and grandchildren of the region. It focuses on a collaborative regional market, one which offers economies of scale, education, quality jobs for an educated work force, international partnership and sustainable peace through prosperity.

I would like before introducing the next speaker, to thank and congratulate and commend HE Sheikh Nahayan and the staff of the HCT for their vision, their creativity, leadership, aggressiveness and professionalism, without which this conference would not have been possible.

Thank you very much for your attention.

Meeting the Work Force Demands of the Future Market

H.E Mohammed Al Abbar
Director-General, Economic Development Department
Dubai, UAE

Your Excellencies, Ladies and Gentlemen, distinguished guests: Good morning.

I'll probably take 15-20 minutes and, if I can just run quickly, I can touch on four main areas.

- General features,
- Education and job markets,
- Human resources development,
- Recommendation,

In my job, we talk about progress, development and prosperity. Of course, for you to achieve that you really need to depend on all sectors of the economy. But remember one thing. Without human resources, all that is impossible. That's why, when we launched our economic plan for this city, one of the crucial areas was human resource development. A lot of people maybe thought that we were putting a lot of pressure, and too much attention towards that, but it's crucial, because it's really the backbone. I agree with what we said earlier, that if you are in your company, your house or in your country, if you don't have the right human resources that are being developed, educated, trained and re-trained, it is impossible to move forward.

Of course in the UAE, we all know that we depend on foreign labour. That's a fact of life. It's not existing only today for these colleagues who are not from the UAE but, since I was 6 years old, it has always been the situation. We have got a low number or low percentage of UAE nationals in the job market, so that's another interesting thing. Of course we talked about participation of women in the work force and that is also quite low. The concentration of the local labour force in the public sector and that's an issue on it's own. You can really speak for two days about this issue but at least we are highlighting some of it.

Now we talk about integration between the public sector and the private sector. The private sector should come forward and put in not only their feed back but their efforts in order hopefully to make that special training or special advice, in order to bring up the national participation in the private sector side of the business.

Before I go into this, I will call this "*the moment of truth.*" I think we all understand that whenever you have a problem, if you are able to highlight the problem it's 50% of the solution because one of the greatest difficulties is living with a problem without knowing that you do have a problem.

Of course you all know that education is a priority. We don't want to highlight too much of that but there's tremendous effort being put in the university, and the Higher Colleges of Technology, and thank God, results are there. But the second point is a real problem; the drop-out percentage is not that healthy.

The third point is that there is no indication that this drop-out percentage is really going any better. This is a serious issue. I think we spoke a bit earlier about the importance of preparing the work force for the years to come, for the next century, as the work force is changing so rapidly. We need to invest even in the educated people, re-train them and prepare them for the years to come. So not only because we have an issue of a higher percentage of drop-outs and people who leave schools, but while this is happening we've got the job market that's getting much more complicated, that requires people with very specific knowledge and certain capabilities in order to make it.

As a result, of course, the first point is that automatically they are already at a disadvantage, and that even makes it a bit worse. Of course we talk about the university graduates, we do not have a high concentration in science subjects. That needs to be looked at.

I'm touching on my recommendation. I touch on the second point - that the development and growth that we are going through requires more technological knowledge and know-how and again I touched on that earlier. We all understand that in all economies that have grown and are almost getting ready to mature, there is a high demand for engineering, medicine and science. So, if we keep driving our economy the way we are driving it, but we're not actually getting the human resources ready to come in and fit with the overall growth plan, there will be a miss-match. Of course you can depend on an expatriate labour force to come and fill the gap, but try to make sure that this gap is as small as possible.

There was a speaker from Singapore here and we reviewed their 10-year plan for preparing Singapore as an IT hub. So Singapore worked about 10 years, opened colleges, trained people. Six years after that, Singapore announced that they were ready to be an IT hub. So, when all the IT companies started thinking about Singapore, the work force was ready. Maybe there was a 20% shortage, but that's OK. They'll make it as they go on. So we don't want a miss-match. Of course as a result, we are concentrating on a certain subject, and there will be too much of that. As a result of course, the job market, or unemployment in these areas is going to be a serious issue.

These are very basic results of not actually going into other fields. Being in the private sector you really have to be a sophisticated, well prepared individual. But if we keep concentrating on certain subjects and not looking into other subjects that the market is interested in, the chance of getting jobs in the private sector is going to be more difficult.

I was trying to think what would be a real solution for education because a lot of times, in your own company, you sort out training and education because it's reflected in the bottom line, in your profit and loss account. So, no doubt you care about human beings and you care about education, and that's for the benefit of the company. So it makes sense, there is a balance, there is a formula. But within a whole country, it's much more than that. It's really the survival and the success and the continuous growth of a country. It is a serious challenge and I think a lot of economies that are coming through growth are facing that. Most probably countries in the Far East have done that very well. I'm not trying to brag here, but most probably nowadays the really wanted graduates are the

Higher Colleges of Technology graduates. So we don't want to be so pessimistic but that's only a view. We have got a lot a good people coming out of very decent institutions and that's the good side of the story.

In some of the organisations that I run, in fact, we have a very specific policy towards the graduates of the Higher Colleges of Technology, because we've had about six or seven years of experience with them. Not only the quality of education but I think it is the mental preparation of these young people. If we talk about the total working hours, how long the working hours are, the change of mentality, the pressure that they go through, it's truly tremendous. The link between the private sector and the Higher Colleges of Technology is really wonderful. So at the end of the day you've got people who are really ready to just jump in and start going. You don't have to worry about six months of training and orientation, and the rest of it, because the private sector doesn't have time for that.

We have got certain programmes within the UAE - that's my second point. We've got a lot of companies who are starting their own training programmes. I don't want to mention any specific organisations. We've got banks and other institutions that have their own very strong training divisions that really have tremendous contribution to the training of national and expatriate work force. We've got specialised schools. Keep in mind that the private sector is coming up as a star here, because the private sector is running these quite well and very effectively as well.

Turning to my recommendations, I think there ought to be understanding and true dedication for the whole process, as simple as that. That's my first point. We highlighted the problem of drop-outs but we've got to put solutions for that as well—the other 50% of the issue.

Talking about career guidance, and a lot of the time I talk about career guidance and career pathing, and truly going back to the students and trying to let them understand what's really out there and at least try to help them think about the real world.

Talking about the unified system of tertiary education with academic, vocational and skill-oriented programmes, getting closer to the private sector which the HCT are doing. A lot of these private entities that are putting these programmes and training divisions within the organisations are very successful. I think we should join hands with them and we should not go and re-invent the wheel. They are doing it so let's just go and take advantage of that system.

This is really coming basically from the overall growth in our economy and therefore we have to go back and train people in these fields, if it's in the tourism industry or if it's in general business. Of course we have to find tools in encouraging students to go towards the science side of education.

Maybe I'm talking a little bit more about the private sector because this is the only way we really prepare people for the real world. We are trying to say that we would let go of the public sector because it's full employment. I don't think the public sector adds to the individual and prepares them for the years to come, for the type of work, or nature of work. Whereas the private sector has the competitive edge, and it changes with the market, and is able to train people for their own needs. So that's quite crucial.

A solution for a drop-out is really to be able to have a part-time system where we are able to encourage them to come back and go through the system. It might take a bit of time but we have to find every possible way to bring these people into the education system and encourage them and possibly bring their knowledge so that they are able to come back to the job market.

The last point, before I say thank you, that I would like to share with you, is that maybe some of you have read a recent article that was published by *Time* about three months ago, where they did an analysis of the most successful nations. Of course it's purely economic, purely growth oriented. So, they are saying which country has the most prospects and promise to still grow and flourish, so they chose the Far East, and specifically, they chose Singapore.

The study was done by UBS and they say the three main reasons are that this country believes in free competition. We understand that, open borders. They talk about political stability, which is fair for business. Towards the end they mentioned education and they elaborated a little bit that they not only wanted to guarantee growth but that growth, without having the proper skilled, trained and re-trained work force to push the country ahead and forward, would have been impossible. Countries that really think seriously about their profit and loss account go back and know that the backbone of their success and the most important element are their people. And I'm glad they say that because we are all gathered here because we believe in that.

The UAE Offsets Programme

Mr. Peter Eident

Project Manager,

Head of Training for the UAE Offsets Group

When I was first asked to talk at this conference, I put together a speech, and after working and talking with you people over the last two days, I've decided to change my speech completely to a number of questions that I've faced, which have come to me:

What in the World Is Offsets?

You're going to have a short course on Offsets, and also because of the time, a speed reading course, so here we go....

Offsets has many names - regional benefits, licensing, co-production, localisation, barter, counter-trade all mean the same thing. Offsets means that, when a foreign company is awarded a large contract by a government, it is contractually obliged to contribute economic activity to the local economy. This contribution will partially offset, hence the word "Offsets," the negative effect of this large expenditure going abroad and, when I mean partially, I mean there's no reason why a company would come here if all the money had to go abroad.

What does Offsets have to do with technology or technical training?

Offsets often involves technology transfer, technical training, increased business opportunities, joint ventures and, in some cases, the creation of entire industries.

How Big Is This Thing Called Offsets?

Offsets magnitude. Over 80 nations have some form of Offsets programme. Almost every large nation in the world has an Offsets programme. Since they've been keeping track, for about ten years, USD 75 billion in offsets have been performed. Currently over USD 100 billion is owed; every major defence contractor is involved. Offsets are cited as a mechanism that levels the technology between the have and the have not nations.

How Did the UAE Get Involved in Offsets?

The UAE has a unique situation. After the Gulf war, it was determined that the UAE would need to procure a large amount of equipment to modernise its armed forces and it also had some other interests. The country needed to continue the policy of wealth distribution and economic diversification. But the UAE had a couple of problems. One, it had virtually no defence industry, no experience in Offsets and few bureaucrats and a small, but expanding work force.

Meanwhile Offsets was changing. Many Offsets companies had become liabilities for their nations. Those companies that had one-off investments, had got their Offsets credit up front and now these companies were starting to fail. In many cases Offsets was unsustainable. Those companies that were created, as technology was created, was appropriate technology and not the state-of the-art technology. Offsets was evolving from direct to indirect. In other words Offsets used to be concerned with the procurement of the specific technology. Now Offsets has to do with any activity because we're dealing with large global companies like UTC.

Offsets was becoming more prevalent but, like smoke and mirrors, there was a lot of credit given but there was no substance behind it, and that became the rule. A lot of litigation started occurring and bureaucrat legions were formed. Canada alone had over 200 people monitoring Offsets in their country and fulfilment became problematic because the defence industry was shrinking. GATT and WTO banned Offsets and the US Government passed a law against it but, like any demand-driven thing, there were exceptions, and exceptions according to security and technology has a lot to do with security, and so essentially those laws have no effect on Offsets. The defence contractor world was changing. Their market was shrinking, technology change was accelerating, dual use was being exploited and corporations were evolving from international to global to multi-local. They know they have to have a presence in order to do business in a country.

How Did the UAE Take Advantage of These Opportunities?

The UAE Offsets Programme. All contractors must form a joint venture in the UAE with local partners, and this is very much unlike the problem in other countries where often they just have to transfer certain technologies. In the UAE , they have to form a joint-venture with local partners. Contractors can pick any type of venture, of course, within reason, that would be profitable. That means the contractor, not the bureaucrats, decides which section should go in, the contractor decides what section he wants to go into. There is only one measure of performance and that's profits, and credits can only be obtained from creating profitable companies. So Offsets isn't given up-front. It's only given when a company is created and becomes profitable.

How Does This Fulfil the UAE Objectives?

The UAE output, we call it output base or profit base Offsets, spreads wealth and diversifies the economy. It creates only logical and sustainable activities because the contractors pick the activities. Incentives exist for contractors to perform through the profit motive not because they are doing something good for the nation, but because they are doing something in their own interest. It's easily audited, anyone can tally the profits of a company, it's non-contentious; we don't need legions; we have one person that's in charge of contracts and one person that's going to monitor it and it transfers the risks of performance to the contractors. No longer does the Government have to take some risks and use up Offsets credits, and this is probably the most difficult portion of it.

What Was the Reaction to This New Paradigm in Offsets?

Well, first of all, Offsets performance; first they didn't like it at all. They kept saying: "this will go away," and they got their ambassadors to parade in and try to change the programme. Then they went through acceptance and then world class performance. Over twenty-two ventures launched through Offsets and a new dynamic in the economy. Over four hundred feasibility studies with hundreds of companies looking at the UAE as the place to go, although some of these companies didn't end up doing Offsets. These ventures went on anyway.

Offsets joint ventures, just some of the ventures that we have; Abu Dhabi Ship building, a collaboration with Newport New Ship Yards, the largest ship yard in the world. The National Science and Technology Institute, a collaboration with Bechtel, the largest contract research company in the world. Gulf Energy Systems in alliance with Duke and a number of other large medical universities, Gulf Diagnostic Centre, Combined Cargo UAE, and we're also focusing on privatisation where we think the biggest opportunity is.

Have there been any problems?

Absolutely. Inhibitors to venture creation. First of all there's a lot of red tape and bureaucratic procedures, which we're working on through the Government to try to change and streamline. Second, the laws here are not fully developed, so there's a lot of risk involved—we're working to develop those laws. Third, there's a need for a trained work force, as I said 10% of them. So what we're talking about is market-driven training. Companies needing training have naturally sought out HCT and CERT for assistance. When I worked for UCT and had to do an Offsets programme in the UAE, one of the first people I talked to in this country was Tayeb Kamali, to talk about how we could work together.

Fourth, people. Seeing opportunities, people say, well there's a real opportunity for this training. We say fine, turn it into a business and make it sustainable. Let's not do a one off where you train say 12 to 20 people and then go away. Let's make sure that you train more and this company is sustainable.

Is Offsets Credit Given for Training?

The word is "no." Offsets is only given for profitable joint ventures. The thinking is that, if a company is going to be profitable, it must train its people on a continual basis. So we're saying that, if you train people, why should you deserve Offsets credit. You have to do it in order to get a sustainable profitable company. Second, if you see a demand in the market, please do go ahead and create a profitable business that would be continual, let the non-profitable training be a part of the Government. They do that part best.

The Future of UAE Offsets

Promotion of value added activities, that's what we're concentrating on. We're not for trading companies. We're looking to put value added in this economy. Second, a closer link to HCT and CERT and, in general, human resource development. Stronger communication with contractors in the community. One of the things we've done is that we've brought on nine new nationals in the Offsets programme, and I've been brought on to help train them in this, and we're really trying to connect with the community and make sure we're on target. Nurturing of businesses that have been launched. There's a real feeling that now that we've launched these businesses, they need help because this is a difficult environment, and we're out there helping them. Last of all I think we're going to see an increased pace of new alliances.

Thank you very much.

The Power of Partnerships

Dr. Tayeb A. Kamali
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The Power of Partnerships

Introduction.

In building a nation to step from an agricultural world squarely into the twenty-first century, it is not enough to prepare our youth for entry-level positions in technical or administrative functions. We must prepare all of our people to make what contribution they have the potential to make. We must not overlook the national employee nearing retirement, for he will make an excellent teacher of the young. We must not overlook the mid-career, mid-management level, technical or administrative, for he has many years ahead and much to contribute. We must not overlook the new graduates of the UAE University or the Higher Colleges or the many Scholarship Receivers returning from overseas with new ideas and great expectations, for we must guide them towards a professional life of continued learning. And we must not forget the expatriate worker, for he helps define the work environments in which our nationals find themselves.

Traditionally, developing countries have looked mostly to educational or technical/vocational institutions to train their youth to assume the mantle of industrial and governmental expertise through entry-level education and training, content for the generations to gradually mature into a developed-nation status. The pace of this maturation process may be too slow, however, for today's reality, and it may put too great a demand on human and financial resources. Through the notion of powerful partnerships, however, some of this demand can be shared by the providers of the material side of a developing country's progress to developed status—the providers of the machines and equipment can, should, and are willing to participate in the development of a nation's work force. It is logical to expect that those who share in the benefits of the economy should share in its development.

Background.

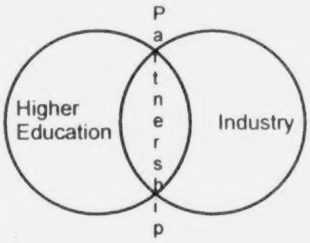
In December, 1991, an article appeared in the *Harvard Business Review* entitled "An Open Letter: TQM on the Campus," written by the heads of American Express, Motorola, Xerox, Ford and so on. The following extract captures the message:

> Our system of higher education is one of this country's most powerful competitive weapons. Working together, companies and institutions of higher education must accelerate the application of total quality management on our campuses if our education system and economy are to maintain and enhance their global positions.

Working together, companies and institutions of higher education!

Relationships between higher education and industry are nothing new. Stanford and Carnegie Mellon Universities came into existence with industry as the catalyst and with industry supplying the capital. But these relationships have not always been true partnerships in the usual business sense of the word. The flow of benefits has frequently been one sided with industry providing funds for endowment, research, university chair, and the like. Historically, one can make the argument that most higher education/industry benefit ratios have favoured the educational institution. As the article in the *Harvard Business Review* suggests, however, there might be greater "power" in a more "give-and-take" relationship between higher education and industry.

In the model that the Higher Colleges of Technology has developed through their commercial and applied research arm, the Centre of Excellence for Applied Research and Training (CERT), the partnership between higher education and industry takes on a different role. In this partnership, the separate entities of higher educational institutions and industry overlap, creating almost a third entity—not clearly distinct but living together in a symbiotic relationship and creating a synergistic ambience in which the sum of the parts is truly greater than the whole:



This model evolved out of the practical, day-to-day encounters with international business groups. When the Higher Colleges of Technology (HCT) were formed in 1988, the vision of our founder and Chancellor, HE Sheikh Nahayan bin Mabarak Al Nahayan, included a strong industrial connection. That is why all of the career programmes in business and engineering in all eight Colleges throughout the UAE have a Programme Advisory Committee (PAC) to make sure that the content studied by the students will help prepare them for the jobs that they will take in the UAE on graduation. Local and international companies are represented on these PACs.

The founders of the HCT also had a shrewd understanding of the role technical education would play in the development of an economy based on the highest levels of technology. This economy would require a continuous, consistent supply of highly qualified employees in a wide variety of technical specialities. For this reason, the HCT took on its great challenge: To provide effective education and training in state-of-the art technologies and business practices in a foreign language. Education on either side of that equation would be daunting enough. Technology in the UAE is represented by the best machines and the latest equipment the world has to offer and this means that the "state-of-the-art" description is an ever moving target. Providing the effective education and training opportunities in a language not the student's own requires that the delivery platforms and methodologies have to be "state of the art" as well.

As the system grew, it became clear that other opportunities to meet the mission of creating a strong national work force existed. The workplace was filled with national "pioneers," men who had received their education and training a generation earlier and had gone into the work force with their expatriate counterparts to develop the UAE's government and industrial infrastructure, to help make the building of a modern economy possible. These professionals already in the work force provide an experienced resource of manpower who can benefit from further educational and training opportunities. But because they are older and more experienced, entry-level training programmes are probably not suitable for this group. And because the companies, especially the oil and banking sectors, are involved in very advanced technologies and business practices, the training and educational opportunities afforded to these employees has to be of a very special nature.

As these observations about the dual nature of UAE manpower development formed over time, i.e. the training offered to qualified school leavers for entry-level technical and business positions and the continuing education opportunities for employed national professionals at beginning, mid- and senior career levels, a different training model began to emerge. This model was developed and enhanced by CERT. It would provide tailored short and long term programmes meeting specific educational needs for all ranges of employees from entry to senior management level, open to national and expatriates alike. Since these courses would be designed for companies and government agencies with a high stake in the UAE goal for national development and since a great deal of this type of training had been done either overseas or by bringing in overseas experts, CERT offered these programmes on a cost-recovery plan. This would allow the country to keep most of these funds in the country and would allow CERT to develop a permanent, self-funding resource for the business and government community to call on again and again.

In the two years that CERT has been operating, it has provided training opportunities for aviation senior managers, oil company executives, English teachers, local construction engineers, the UAE Army and Air Force, the HCT, a local private automobile company and so on. CERT has just signed an agreement with the UAE Armed Forces to work with the Directorate of Medical Services to set up a Nursing School.

Both because of the complexity and diversity of these training programmes, CERT has had to look not only within the international resources of the HCT but also beyond. What may be an appropriate background in terms of training and experience for a course in general marketing may not be adequate for the alignment of marketing managers with an average of twenty years experience successfully conducting business in the UAE. The approaches and generic equipment used to teach DC and AC Fundamentals to a group of first year Electronics students may not be suitable in a classroom of experienced telecommunications experts from all over the world.

Throughout its eight year history, the HCT has been sought out by international groups: Universities and multi-national companies have frequently contacted the Colleges to discuss collaborative projects. Until CERT came along, however, there was no dedicated part of the organisation that could develop these relationships further than general agreements to work together on a variety of projects, usually including joint research projects, faculty and student exchange, and programme articulation.

As the opportunities for deepening CERT's and the HCT's international connections became defined, it became clear that many of CERT's goals and the general mission of the UAE Offsets Group were similar. CERT was trying to develop a series of self-sustaining businesses, usually associated with training, in co-operation with international companies who were doing business with the UAE . One of our first joint-venture activities came about through an opportunity with a company actively developing a whole range of projects to help meet its UAE Offsets requirements: Westinghouse Electric Corporation. Because of earlier sales, Westinghouse was obliged to create self-sustaining, profit-making businesses to receive "credit" towards that obligation. CERT and Westinghouse began talking about how they could work together and a number of projects were identified.

During CERT's analysis of the training needs in business for middle-to-senior management, the concepts of process reengineering and continuous improvement kept coming up. "In the century ahead natural resources, capital and technology are going to move around the world. Skilled people become the only sustainable competitive advantage", insists Lester Thurow. These skilled people will have to know the technology and the management practices needed to harness the full benefits of those "natural resources, capital and technology".

In the course of discussions, CERT discovered that Westinghouse had been one of the pioneers in Total Quality Management implementation and measurement tools and that through its Productivity and Quality Centre at Pittsburgh, it had helped the corporation win the US National Quality (i.e., the Malcolm Baldrige) Award for Quality in 1988. To make a long story short, CERT and Westinghouse determined to transfer the technology and information from that Centre to the UAE and to establish the Productivity and Leadership Consortium as a UAE Offsets Project.

A different type of arrangement was made as part of a strictly "business" agreement with one of the world's leading companies in telecommunications: Lucent/AT&T. In this agreement, a more traditional joint-venture relationship was developed to set up the "CERT/AT&T Technology Centre" at the CERT Technology Park. This Centre offers regional telecommunications professionals courses in fibre optic installation and maintenance, network engineering and design, WaveLAN installation, training on active components, etc.. CERT and Lucent/AT&T share in the profits and the responsibilities. They also share in the development of new product lines and projects.

Through powerful partnerships like those with Westinghouse and Lucent/AT&T, CERT has been able to provide the professional community working in the UAE with training and consultancy resources previously available only overseas, primarily in the US or the UK. These world-class resources have been tapped through business and joint-venture relationships that seek to be and have been largely self-sustaining. In other words, these relationships are producing their own revenues to help make sure that the resource remains functioning for as long as the need for the training and consultancy services continues.

The rest of this paper will explore the nature of the CERT/Westinghouse and CERT/AT&T relationship in more detail.

The CERT/Westinghouse Gulf Productivity and Leadership Consortium: A Case Study

On 5 November, 1995, HE Sheikh Nahayan bin Mabarak Al Nahayan inaugurated the CERT/Westinghouse Gulf Productivity and Leadership Consortium (Westinghouse Gulf was Westinghouse's Offset company set up with the Western Group).

Throughout CERT's short history, it had kept running up against the need to provide government, business and industrial clients with information and services regarding Total Quality Management. At the time, there were many providers of two and three-day short courses on the subject but there was no permanent source of expertise that could work with companies on a long term basis to help with the implementation of Quality Management Tools and Techniques, which relate directly to the increased productivity and continued development of the work force if handled effectively. Thomas J. Murrin, the founder of the Westinghouse Productivity and Quality Centre and now the Dean of Duquesne University's Business School, believes that

> The effort to incorporate Total Quality in the academic community is one of the most important things happening in our country, because it deals with the central issue of supplying human resources to the key organisations in our society.

The goal of the PLC is to provide consultancy and business reengineering services to help local companies and government agencies successfully implement Total Quality Management tools and measurements as developed and refined by the Westinghouse Productivity and Quality Centre. A corollary goal of this organisation is to adapt these practices to the social culture and general business practices in the region and to develop a research base for further enhancement of these tools and methods for this region. This means that the Director of the PLC, a former Westinghouse PQC employee and pioneer of the techniques, will work with assigned teams within the client's corporation, train them in the use of the tools and help them through the various stages of the implementation process. To be able to do this effectively, this person needs a permanent presence here.

Starting in April, 1996 nearly a year ago to the day, the Director of this joint-venture group moved to Abu Dhabi and opened his office at the CERT Technology Park. Since that time, he has been writing proposals, making presentations and getting contracts to provide consultancy and training for the local professional community. To date, the PLC has

- presented a public seminar on TQM topics
- worked with a leading aviation company to redesign a major process
- provided management realignment training for 80 senior managers of one of the OPCOs
- developed a strategic plan for a major private automobile company in Abu Dhabi
- taken on a long-term series of process improvement activities for one of the OPCOs
- engaged in a long-term contract to develop a GCC national training plan and to administer that plan

- is developing a long-term relationship with one of the major medical authorities to develop and administer a long-term national training programme
- is in the first stages of negotiations with the UN to develop a partnership approach to restructuring and retraining key personnel in one of the federal ministries
- has established the Forum, a paid membership group of local companies and institutions dedicated to the promotion of Productivity and Quality enhancement practices throughout the membership body

The Forum is a model of the powerful partnerships we are discussing. It is a consortium of academia and industry. In 1991, at their third annual conference, Bob Galvin, Chairman of Motorola, issued the universities a challenge: If a given university would send 100 of its faculty to Motorola for a week, the company would teach them about quality and future industrial needs.

This invitation started the "University Challenge" partnership between academia and industry. That challenge continues today at CERT, whose current Director of the PLC worked with the University of Maryland, the University of Pittsburgh, and Virginia Tech to help teach administrators and professors within those academic institutions what the Westinghouse Productivity and Quality Centre had learned in the "hard-knocks school" of supply and demand.

All of these CERT/Westinghouse Gulf Productivity and Quality Centre activities are aimed at making the work force in the UAE more productive and provide some very high level training opportunities for UAE nationals at various points of their careers in the UAE business and government community. CERT's participation in this type of work would be very limited without the resources provided through the partnership with Westinghouse Gulf.

In this relationship, CERT is better able to provide the marketing contacts and the local presence that helps to make this type of service fit the need. CERT is also able to provide the operational infrastructure, the facility and on-call support in training facilitators, proposal writers and project team members, especially when subject matter experts are required. Westinghouse Gulf supplies the information and technology that it developed through its Pittsburgh based Productivity and Quality Centre from 1979 to the present. It is able to offer its tried-and-tested experience in implementing these tools and methods. The funds that these projects are generating are supporting these activities and making it possible for them to continue on into the future.

Finally, the experience gained in the application of these TQM approaches in business and government operations has been fed back to Westinghouse and is available for sharing with Westinghouse operations in the US. This partnership derives its power from the fact that the relationship is a "two-way street" of information flow. "Information is one resource that increases when it is shared".

The CERT/AT&T Technology Centre: A Case Study

In the fall of 1995, AT&T Global Private Networks (the Lucent/AT&T company responsible for the sales and technical support of the structured cabling division) was conducting most of its training in support of its sales in the Middle East in many different countries. This meant that an instructor and about

$1,000,000 dollars worth of equipment had to be shipped in and out of countries on an as needed basis, at a great cost of time and money. Equipment needed for training in Pakistan, for example, might be stuck in Saudi Customs for weeks.

As a gesture of co-operation, Lucent/AT&T offered to build an "Intelligent Classroom" for the Higher Colleges. This state-of-the-art presentation room features video conferencing, complete environmental and pedagogical control from a central console, full multi-media presentation facilities and structured cabling with mobile modular connections to enhance the reconfiguration of the room and student stations to fit the presentation needs of the content being taught. During the discussions and the collaborations that took place with the establishment of this $250,000 facility, our partnership was born.

CERT was just becoming operational at that point. Why not join forces with Lucent /AT&T to open a training facility where Global Private Networks could support its Middle East training needs from a permanent site in Abu Dhabi and where CERT/HCT could provide its students, faculty and technical staff with opportunities to get advanced training on the latest equipment and practices in computer networking and telecommunications?

In January, 1996 the CERT/AT&T Technology Centre offered its first class to a group of telecommunications technicians from Saudi Arabia in a temporary 300 square metre facility adjacent to Abu Dhabi Men's College. Within five months, demand forced us to move the facility to its present 680 square metre site.

How does this partnership work? There is no rent involved; CERT is not a landlord. Instead, CERT and Lucent/AT&T identified a series of joint ventures which would involve money generating activities that would support AT&T's presence at what would become the CERT Technology Park. Initially, we identified three courses needed to support Lucent/AT&T resellers in the region: Installation and Maintenance of structured cabling for Intelligent Buildings, Network Design and Engineering, and WaveLAN. Since the start of our relationship, we have trained over two hundred practising technicians, including about 10 HCT technical staff and over twenty HCT students.

In this partnership, CERT helps to market the courses through its contacts and provides most of the administrative support—the registration, the local travel and hotel accommodation, catering, arrangement for visas and so on. For this service, CERT earns a percentage of the course fees.

As the partnership has developed, there have been other areas of collaboration. CERT, as part of a federal educational facility dedicated to innovation in technical education, has developed a series of "products" in collaboration with its strategic partners. Lucent/AT&T has lent technical and product support to these efforts.

One educational product that CERT is promoting throughout the UAE is the "Computer Lab Without Walls." This lab represents a consortium of hardware and software providers. Through Innovative Technologies in Education (ITE) we are offering several highly interactive, multi-media software products like the 300 hour English language package *English Discoveries.* We are offering a CD-ROM version, a CD-ROM version with Acer Aspire Computers (supplied through another partner and AT&T reseller, Emirates Computers) and a network version connected to a file server through WaveLAN, Lucent/AT&T's wireless network solution. It is this last version that provides the opportunity for the Computer

Lab Without Walls, for with WaveLAN, the computers can be moved anywhere in a building within about 300-500 metres of the indoor antenna connection, to be plugged in and turned on with immediate access to the network. Teachers have the flexibility of sending their students to one central location (the traditional computer lab), wheeling a computer into a standard classroom and hooking it up to a projection system and making a classroom presentation using the software available on the network (including video and audio multimedia). Alternatively they can bring a few computers into the classroom to provide remediation or enrichment activities for students who are falling behind or who want to develop ahead of the class.

Our partnership with Lucent/AT&T has created a new product, a new application for a standard AT&T product giving both partners a chance to meet their goals through a way which would not have existed except for the partnership. This product provides Lucent/AT&T with a new application and a new market. It provides CERT with a way to help develop the training and educational delivery mechanisms within the HCT, in the oil companies' active training programmes and facilities, for the military and so on. And this new product gives both the opportunity to meet funding needs to keep the facility functioning into the future.

As this partnership moves into the future, new opportunities are and will continue to develop. As this paper is being given, a new lab at the CERT/AT&T Technology Centre is being set up. We are completing our telecommunications and network services by adding an active components training facility to our arsenal of high tech abilities. Lucent/AT&T, Madge, Cisco, 3Comm, Bay Networks and the like have supplied this lab with the latest in hubs, routers and ATM switches. The CERT/AT&T Technology Centre will, of course, provide training in support of these companies' resellers as in the model with the fibre optic cabling of Systimax and with WaveLAN.

But there is an added value to this lab since it supports many different vendors and it will simulate virtually any networking configuration that communications and computer engineers can design. It gives CERT the opportunity to set up an independent testing lab. The CERT/AT&T Technology Centre can offer the business, government, and industrial community in the UAE and the region the opportunity to test out network systems and active components before they buy them and have them installed. This testing centre will be able to offer buyers the chance to see the networks, designed for them by system integrators, functioning before they accept the offers. This facility will give buyers the chance to avoid costly mistakes by installing a system that will not meet their present and future needs.

There will be fees associated with this service and CERT will move into a different level of service: Applied Research.

The model of the CERT/AT&T Technology Centre is one of several that is being developed at the Technology Park. The synergy created by the proximity of our different areas of expertise and by our different institutional missions creates the opportunities for synergies that would not be possible if each of us were trying to go it alone. Likewise, our mutual need for a self-sustaining source of funding which will permit the continuation of the operation, sets up a symbiotic give-and-take partnership and provides the motivation to co-operate as though we were part of the same institution and mission.

Conclusion.

How do these powerful partnerships benefit and move forward the cause for manpower development?

They, of course, provide the traditional benefits, for they:

- ensure that the Colleges and their programmes keep close contact with international business/industry and this helps keep them up to date
- provide opportunities to give students, faculty and staff professional development training on advanced, state-of-the-art equipment, systems and practices
- help the Colleges develop a laboratory/knowledge resource equipped and/or staffed without cost to the College

In addition to these come some more unusual benefits:

- the programmes and the partnership are self-sustaining
- the surpluses can be turned back into the relationship further to develop capability
- both partners have a greater level of commitment to the relationship because its survival depends on the success of both partners separately and together within the partnership
- the credibility of both partners is enhanced
- the range of offerings can respond quickly to equipment and market changes
- the training can be tailored to fit the market, the trainees and the social culture because the partners live in close proximity to one another and have greater opportunities for communication

The two partnerships discussed in this presentation are not the only ones in which CERT is engaged. As of this date, Honeywell is in the physical process of moving two of its major regional operations into the CERT Technology Park: The Process Control College and its Industrial Centre of Excellence. CERT and SGI/Cray have just established the "SGI/Cray Educational Centre at CERT" to jointly set up an SGI O2 Lab for SGI staffed training on a wide range of advanced computer topics not available outside of Europe. Dornier will move a presence into the Park over the summer and several other powerful partnerships are in the final stages.

Through these powerful relationships, the UAE, the HCT and the region have access to the best that the industrialised world has to offer—and this best is dedicated to the development and enrichment of our manpower.

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Meeting the Work Force Demands of the Future Market

Mr.Gordon Beaumont
Independent Advisor
National Training Organisations to the British Government, UK

Your Excellency, Ladies and Gentlemen—good morning:

I'd like to say thank you first for inviting me here. It's a great honour and pleasure to be here. Two things in particular have struck me since I came. The first is the warmth, kindness and generosity of the people here and the second thing is the sharing of so many similarities between the various countries, and particularly, the diagnosis of His Excellency this morning of the issues which we have here.

I'm concerned here today with vocational and educational training. I'm not concerned with general education, nor am I going to talk about general national educational qualifications, which John Hillier talked about yesterday.

I would like to stress that, despite the fact that I'm here to talk about training, the strength of partnership between employers, employees and education is what brings power to the relationship, and to performers. The Chairman said that he was the only person here as an employer. I would like to stress that this is my role. I am not an educationalist. I'm here as an employer and what I'm going to do, if I may, is talk about some of the things which I've learnt over the past couple of years, when I've been working initially to review the national vocational qualification system for the UK, i.e., England, Scotland, Wales and Ireland, but also about acting as the Chair of a panel which is setting up training organisations in the UK.

In the UK, our national vocational qualification system, what I'm going to call the NVQs from now on, and embrace SVQs which is the Scottish version, are designed to deliver competence. We defined this as the ability to apply knowledge, understanding and skills in performing to the standards required in employment. Importantly, this includes solving problems and meeting changing demands. I think you'll see that, by definition, this would meet the heading for today's session, i.e. *meeting the work force demands of the future.*

The qualifications were progressively put in place from the middle of the 1980s. Changes were made for many reasons, which have been identified already. But primarily, because what we had already wasn't delivering what was needed to survive in today's competitive world. I'd like to suggest that there are four key questions, and I'm going to address all of those this morning. You may pose others, but those are the ones which I have selected, so bear with me please.

Turning to the first one: *"Is education based on the needs of employers?"* Before the introduction of national vocational qualifications, I would say the answer was not very often at a national level. It couldn't be, primarily because employers had not defined what standards they needed nationally. Employers had a number of other concerns. There wasn't a coherent national framework for vocational training, and it was not integrated. They were concerned that while some school leavers were able to compete anywhere and were the best in the world, unfortunately, there were many young people leaving the education system which was failing them. Perhaps even more significant was the fact that vocational training was education driven and this resulted in it being supply led and not demand focused. Therefore, it was based on inputs and not outcomes, it was based on knowledge required, not the outcomes they would achieve. So they delivered knowledge and understanding but not their application.

What they were assessing was knowledge and understanding, but not competence, the thing which employers needed. Employers anyway, say that education can not really, usually, demonstrate the application of knowledge and understanding, because they say it needs to be integrated and demonstrated at work. But what we have now, I am pleased to say, is through the new system, the facility for this to be done in partnership.

Another draw back which employers identified was the rigidity of the educational system. It couldn't meet the variety of needs of employers, particularly the content and timing of delivery of education and the methods and timing of assessment. Nor are the narrow traditional assessment methods appropriate to the demands of the work force, because there is a huge variety of needs, of occupations and levels.

Furthermore, sadly, it failed many capable people who were not able to demonstrate their abilities when assessed by traditional methods. Perhaps more importantly, employers need to know that their employees can actually do all the things they want them to do and traditional assessment didn't actually do that. What it did was to have statistical probability based on an assessment of a choice of questions from perhaps 30% of the syllabus, and assuming that the past rate of 50% led to success. Employees could not satisfy employers at a pragmatic level although they would accept that it is the right foundation for the starting point. Nor could the traditional approach actually cope with the variety of company and individual needs. Nor could it adapt quickly enough to the ever changing demands.

I think most of the answers to the question lies in the second point: it starts by asking *"have employers specified what training they need, not only now, but also in the future?"* Employers' needs are specified as part of the base of accreditation for the qualifications which we're talking about. The first requirement is that there should be a nationally specified standard for performance in employment. These are the foundations for national vocational qualifications.

As I've indicated already, they must state what a competent employee is required to do and, remembering that it's not only the basics, but it's also the problem solving skills, and it's also anticipating the future. They are now actually available for over 90% of occupations in the UK—a major exercise.

What we're trying to do is ensure that the standards meet employment needs by requiring that their creation is led by employers, but importantly and significantly, in partnership with education and employees. We would all agree that this is essential if the standards are to be held—they are actually addressed to employers. Knowledge and understanding are key elements of the qualifications and, as I mentioned already, we have to look to the future, and we have to include leading-edge performance. In qualifications, however, the leading-edge element is a leading option, otherwise it would preclude those companies not at the leading-edge, but it gives them something to strive for.

There is a process for a regular review of those standards to ensure that they remain up to date, but importantly, we now require separate specifications for the tremendous variety of uses to which standards can be put. These include not only manpower planning, job description, recruitment, appraisal, learning programmes and assessment and also, of course, the qualifications to which the primary purpose was originated. A fundamental characteristic, so attractive to employers and candidates alike, is that learning must normally allow any method, any time scale and any location, something quite alien to traditional educational methods. The work base for qualification, all they require is flexibility. Similarly, assessment needs to be appropriate, and this is the key.

In future, the strategy for this would be determined by employers. Methods would not be based on learning but on the outcomes of learning. They should judge outcomes, not inputs. They will assess performance to required standards and, as already indicated, must cover 100% of a variety of methods required, simply because, as I said already, there is a variety of jobs, a variety of types of units to be assessed, and there is a tremendous variety of levels. No one method could be appropriate for this. So we believe there should be a selection of methods supported by internal and external verifications.

The research from my report last year showed not only that 80% of candidates liked the methods used for assessment but that employers did too. They said that, importantly, it produced competent employees and surely that's what counts. Of course it does not exclude the important element that education can and should bring to this.

It doesn't preclude them being involved in delivery and assessment but, what it does mean, is that we have identified that education usually can not demonstrate the final element of that, which is its application. So, by these means, performance to national standards can be achieved at work. It's important too, that there are no artificial barriers to access and progression.

I mentioned already some of the people are being excluded by traditional education and so we do not allow any prescribed entry qualification. You could imagine that this is highly motivating for people who have been unable previously to demonstrate their ability and to gain recognition.

The final requirement is that the qualifications must be free from discrimination. Do employees know what they have to do to meet employer needs? One of the surprising things, again from the research which was involved with my report, was the value which employees attached to knowing what was expected of them. This tends to suggest to me that they didn't know before. I would also suggest to you that there was a similar problem with education. At best, students knew what they were expected to learn, but they didn't know how this would meet employers' needs. This is one of the many reasons why the qualifications proved so popular for so many employees. In addition to allowing them to learn at a speed and style appropriate to them, they also allowed them to be assessed in appropriate ways.

Finally, there is a system for bringing all this together that is required and we have one in the UK now. We have learnt a lot of painful lessons over the past few years by allowing far too many organisations to be created. I have mentioned before and it's been mentioned by earlier speakers, how important partnership is. We now have four organisations. We have the Qualifications and Curriculum Authority, combing both education and vocational interest. They were until quite recently separate. This includes the accreditation of the NVQs, the awarding bodies, but we are going to have far fewer of them creating and awarding qualifications. We have Training and Education Councils which act as catalysts regionally for education training enterprises and also for awarding grants. The new emerging structure, which I am helping to set up, has National Training Organisations, the strategic bodies, which, unlike polytechnics, represent regions, actually represent a sector and deal with the strategic matters of employment and education and training matters. They complement the work of the Training and Education Councils.

Important strengths of this new structure are the bringing together of education and training which is vital, I think, and also the meaningful employer involvement, and their strategic nature. The introduction of such fundamental changes, as you can imagine, has not been effective without a great deal of effort. It has had to overcome resistance from those clinging to the past, particularly those who felt they have much to lose. Perhaps we didn't handle it as sensibly as we should have. I stressed that partnership was essential and I think this could have strengthened those earlier arrangements. The power of this is now evident to all to us.

Another lesson was the pace at which changes were carried through the UK. Competitiveness was very low at the beginning of the 80s. I'm glad to say that it is turning round and we, as you heard yesterday, are now leading Europe in that respect. But because of that early low productivity, we felt we had to do something quickly and, sadly, we made a number of mistakes as a result of that. The image of the qualification structure actually suffered as a result too. That's why I was asked to come in a couple of years ago to look at the way NVQs and Scottish vocational qualifications were actually being implemented.

What the research did show was that there was tremendous and widespread support for the concept of the qualifications but, unfortunately, there was a good deal of criticism about its implementation. So, my report actually aimed at trying to retain the characteristics and qualifications, which were valued, but at the same time, to make them more accessible and more user friendly. Some key changes were recommended to the formal structure of the standards. There were recommendations too, to strengthen assessment but, at the same time, to try to reduce its burden and also to rationalise and to reorganise the structure, which is what I am being asked to do something about now. To improve the quality of guidance and also to remove a lot of unnecessary bureaucracy that has been created as the system was being built up. The recommendations are already largely in place and the structure which I'm helping with should finally be put in place later on this year.

I would like to conclude by showing you some the benefits which users have actually claimed by using the qualifications. First, employers; you see there are two sets of percentages. The second set of percentages relate to Scotland as my research was split into two. Scotland was taken separately from the rest of the UK, and you will see that the Scottish figures are different but they are consistently higher. There is a reason for that but I won't bore you with it. You could see that employers are clearly pleased where they have used them and where they've tried them with the outcomes. One thing which surprised me was that improved productivity was not higher. When you look at the other elements there, I think the major reason is that, unfortunately, many employers didn't actually look at the strategy for training and development before actually deciding on the use of vocational qualifications. Where they haven't done that, the result has been that they haven't been able to take advantage of the skills which they have created.

Similarly, with individuals. Very high percentages again for the benefits which they have claimed to have gained by going through those qualifications. Some of those relate to the characteristics of the qualifications and others, as you'll see, relate to what they have actually got from taking the qualifications.

What I would like you to remember is that those statistics were gained on a product that needed improving. What I am looking forward to, is a further survey once the changes are embedded.

The International Experience of Technological Training

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I. Aim of the Presentation

The aim is to focus on the following few items of cardinal importance for the quality of technological training.

1. A consistent and effective system nation-wide: a report will be presented on the main characteristics and specifics of the system implemented in France for technological training.
2. A system that matches the capability of a country and responds to actual needs, the presentation will address the question of optimising the methodology for building a system of technological training in a developing country.
3. A proper maintenance and control of the system: the conditions will be identified for keeping the training system, once built, on-line with the changes in technologies.

II. Technological Education and Training in France:

1. early in curricula : making the use of technology familiar
2. economic and industrial integration / links
3. spanning the whole educational system
4. primary school
5. secondary education
6. higher education / academics
7. national standards / control
8. flexible : skill oriented / object oriented
9. diversified spectrum of open options: in terms of topics and levels
10. interfaced with general education
11. syllabuses and programmes tuned in to the economic needs and the technology changes

Technological training at Primary School Level

- very diversified from computer practice ("playing with") to wood carving, cooking...
- mainly oriented towards "hands-on" and "progress and discovery through use" (no theory : only clear and first level explanations).

aim: allowing pupils to display specific talents, including inclination towards specific fields

interest: reveal and develop talents and skills facilitate further orientation drawbacks: intense preparation by teacher(s)

high recurrent cost per pupil (equipment maintenance, running expenses), if compared with traditional primary school teaching

evaluation and results (base: ten past years): positive

- mind stimulation
- facilitated integration in domestic and everyday life in a technical environment
- detection of strong inclination(s) and (or) capability

Technological training at Secondary school

A) *duration:* five to seven years

B) *increasingly diversified*

  - in thematics
  - in target (depends on further education step)
  - in levels

Details

- *two first years:* identical and compulsory for all
- *beginning of the third year:* options available
  a) either short job-oriented training: 3 years ("short stream")
  b) or training oriented towards future higher education: 5 years "long stream"

a) The job-oriented training offers three possible streams

- C.A.P.: craftsmanship apprenticeship
  - 3 years
  - 50 % theory in school / 50% on the job-training (contract school employer with tax bonus).
- B.E.P.:
  - 3 years
  - 100% in school with 50% training in workshops.
- BAC-Pro: further 2 years after B.E.P.
  - (B.E.P. and BAC-PRO are both job-oriented diplomas).

b) The so-called "long secondary training" leads to the Baccalauréat, which is very similar to the A-level in the British system.

Depending on the personal inclination and/or skill of each young student, he or she will, after a total of four years in a secondary school, orient his or her curriculum either towards a content of 80% theory/20% technology and practice, or 50% theory/50% technology and practice.

At the end:

- the baccalaureat (diploma) may be obtained (national success rate: about 65-70% of the candidates) indicating the specific stream followed in the previous 2/3 years.

- the baccalaureat is a diploma that carries an automatic permission to register in French higher education (although some streams have numerous clauses).

In summary, regarding the technology training, the secondary school may be characterised as follows in France :

- increasing specialisation of skills and levels
- diversified levels of skills (and diplomas) for the end-users/employers
- full-scale technology-oriented stream up to A-level (baccalaureat)
- remedial special courses for bridging: for instance, a young student holding a B.E.P. may re-enter the technology-oriented long stream (aiming at Baccalauréat) through special bridging courses.
- The aim of the system is to effectively interface and match the wishes and the capabilities of the young students with the needs of the economic and industrial sector.
- Drawback: too many young people attracted to higher education through the "general stream," have in mind that it "pays more," selecting finally a white collar career with sometimes less income than many blue collar positions heavily sought for by employers.
- Possible remedy
  - based on the observation that young people have frequently wrong mental representations of intermediate jobs
  - currently implemented: national training scheme (optional for young students) with built-in on-the-job periods. In this scheme, the young students are given alternate training periods in the school premises (mostly oriented towards rationalisation and theoretical under-standing devices, machines a.s.o) and training periods in industries for practical application of the principles they have learned and "live" application to machines and devices.

Technological Training in Higher Education

Typically among the most advanced countries in modern technologies, France has built in the last 500 years an increasingly adapted system for training in technology at academic level.

In this system, a diversified set of degrees illustrate the large scale of available levels in technological training: after 2 years in Universities (D.U.T., D.E.U.S.T.), after 3 years (following 2 years of preparation in national contests for entering these 3 years) in specialised engineer schools (Engineer), after 4 years in Universities (M.S.T., I.U.P.), after 5 to 6 years in Universities (D.E.S.S.).

III. Training in Technology: a Major Issue and a Vital Stake for a Modern Country

It is assumed that a country cannot be ranked among those who will exert durable influence in their geographic area or on the world affairs, unless its economic and industrial substrata exhibits a reasonable capability for accommodating and using, on a short time-scale, the endless process of the technology evolution.

Keeping this point in mind, it is essential that a country, in the economic system, has the proper technological skills available at the proper locations and at the appropriate time. In this way, there is no means of bypassing the necessary step of training in technology: In building a training capacity in the field of technology, careful attention will be given to the requirement that the training system will at least match the following expectations:

a) a diversified set of terminal diplomas and degrees, corresponding to distinct, well identified levels of technological expertise and complexity

b) the degree/diploma will give people not only skills for a specific function, but also skills for further learning capability, in order to adjust to future technology changes

c) the content of training curricula shall be determined with end-users/employers

d) a national control of the quality of the teachers (national school with highly skilled trainers, i.e. master teachers, for future teachers), including refreshment periods for teachers

e) national standards for the given diplomas/degrees, and therefore a national guarantee of the level for further international equivalent agreements.

Meeting the above requirements will

a) enable the country to enter the circle of countries that consider each other as partners, rather than split into customers and sellers.

b) enable the country to develop on its own in the field of technology (industrial development, research and development).

IV. Training in Technology: Linking Economic Growth to Knowledge

The training in technology is a strong driving force for industry development. It is important to remember that enterprises cannot properly cope with the technology trends unless their human resources acquire and maintain an appropriate level of *Education in Technology*.

Education in Technology means not only acquiring a specific technological knowledge and a proper practice on equipment and machines, but it is, in addition, a consistent understanding—which may be at different levels—of the rules governing the economic or the industrial process in which these machines and equipment are involved.

In other words the mark of a good education in technology is not only that the person makes the most efficient use possible of the machines, or equipment, or methods in their expected function, but this same recipient or user shall be able to propose a more efficient use of the expected function or also to propose improvements to the machines, equipment or the methods themselves.

Taking into Account the International Environment in Technology

Most countries want to obtain significant areas of the world market in technology. Yet, unequal levels of developments have been reached up to now, so that some countries have already a full control in the elaboration and the implementation of the technology, while others have not reached that point. The latter, therefore, have only access to the technology through partnerships involving more developed countries.

Of course, there is a legitimate wish of the new industrialised countries to create the conditions for their independent access to the technology. Among the preliminary conditions required to ensure such a move, is the existence of a full range system capable of educating large amounts of people in the use, implementation and improvement of modern technological tools.

In other words, a given country cannot develop significant indigenous production of technological innovation, unless a proper background exists in education. Based on the current indicators, the world production of technological innovation is currently located in three main geographic areas: USA, JAPAN, EEC .

A good indicator of the technology produced by a country is the number of patents taken by this country. Usually, a significant comparison between countries may be drawn from their share in the patents taken either in the USA or in the EEC.

On this basis, for instance, the share of the patents taken in Europe (EEC) during the year 1993 was the following:

France	8.3%	EEC	45.6%	Western Europe (not belonging to EEC)	
Germany	19.6%	USA	28.1%	Others	3.2%
U.K.	5.6%	Japan	19.7%		3.4%
	33.5%		93.4%		100.0%

The following comments emerge from this distribution:

- EEC, USA and Japan are the source of more than 90% of the patents taken in Europe in 1993.
- No significant competitors are close: the closest country is Canada with 0.9%.
- The developing countries (N I C) in south East Asia accounted for a modest share (0.6%), but it is worth noting that it has been growing fast in recent years.

If the share in the patents taken in the USA is considered instead, the three major sources remain EEC, USA and Japan with 92.3% of the total, the other countries being less than 18% together.

For a given country, another significant indicator of the power of innovation in technology might be the importance of scientific publications. The expression "scientific publications" refers to the publication of new results in science and technology in scientific specialised international "journals with referees". This comparison leads to similar conclusions to those drawn from the patents taken.

The above differences, based on these criteria, clearly illustrate quantitatively what challenges the new industrialised countries are facing to reach a global access to the innovation in technology.

The Substrata: Enabling a Country to Share the Developments of Technology and to Benefit by It

If the present state of the world shares in terms of technological innovation have to change in the future, with emergence of more countries contributing to the process, two major conditions should be met in these countries:

1. Existence of an appropriate frame and environment, both socially and economically favourable.
2. Building a strategy and making proper financial and human resources available for effective implementation of a system of Education in technology.

Consider first what are the implications of the *first condition:* a socially and economically favourable environment. It is based on the well known observation that a consistent and open economic system shall prevail for allowing innovations in Technology.

Obvious examples were available in the world in the past decades, illustrating that the absence of an open economic system precludes a true education in technology, with immediate detrimental effects on the innovation processes.

What are the sources of the innovation processes? It is true that, owing to the global characteristics of the world economy, the big companies brought major contributions to the innovation in technology. However these companies have now reached comparable performances worldwide, as they frequently distribute activities in many locations and several countries.

On the contrary, small and medium industries still exhibit important differences from a given country to another. This is true in their strategies, in their international development, in their technological level of advancement, in the financing modes for their investments. Also the macroeconomic stability is quite different from one country to another. This general pattern is sometimes identified in the concept of local competitivity of areas, as opposed to the concept of effectiveness in the world competition.

Despite the availability of human resources trained at the proper level as a key point among all those features, it is even more crucial for small companies, which cannot develop any adjustment training capability on their own.

The result of these social and economic parameters on the competitivity of geographic areas in the world stems from the addition of both the well-balanced activity spectrum of the big companies, with no major difference in any of the geographic areas, and also the specific dynamism of the small and medium enterprises, differing from one geographic area to another.

As a result, the global pattern of dynamism in technology varies from a given area to another one. This is a determining parameter because it is a component of the active substrata enabling an effective education in Technology.

The *second condition* shall be considered here. There is a requirement for a consistent and effective strategy of Education in Technology.

Developing such a strategy requires at least the following compulsory elements:

1. clear identification of the final target
2. building and implementing an operation scheme oriented to target
3. availability of financial and human resources to implement the scheme
4. evaluation of results, and proper feedback to the education system.

The target of the education in technology is to ensure the people who received this education capable of receiving, understanding, transforming and using for production a given amount of scientific and technical information. In other words, the target is to ensure they are capable of using scientific and technical informationefficiently.

"Using scientific and technical information efficiently" has a specific meaning here.

It means the people at work in the enterprises shall simultaneously

a) have acquired a knowledge of techniques and corresponding scientific background,

b) have acquired a good practical knowledge of the industrial process(es), as a whole, on which this technique is applied

c) have been routinely kept informed on the evolution of these industrial processes, on the limiting steps for improving them and on feedback of the responses given to the identified problems in the processes.

Therefore the implementation of a consistent system of education in technology requires an early introduction in the formal education system, and includes opportunities for close interactions with live and active technology in enterprises. (Example: the above reported close contact with technology at primary school level in France makes the use of simple technology familiar to pupils).

The content of the curricula shall therefore include not only the usual splitting into

- formal lectures
- tutorial work
- laboratory (workshop) activities

but, additionally, it shall incorporate active, "on site and hands on" immersion periods in enterprises.

Such periods in enterprises shall not be open only to the higher level of those enrolled in the education system. It is now understood that it is highly profitable that the students feel familiar with the industrial network from the very beginning of the secondary education stream.

As this point might perhaps not be shared, it is worth to support it through a short reminder of the most recent available information on how innovation occurs and develops in the enterprises.

Schematically, our understanding of the innovation process changed in the past decade from the previous "linear scheme" to the "interactive scheme."

In the linear scheme , the innovation in technology was understood as the result of a one way process in which the new concepts created by fundamental research were introduced into the enterprises through appropriate "interfaces / technology shops" namely (specialised persons or structures), for use in the production units.

This scheme, although working well in some situations—especially in very large companies—actually accounts for a small percentage of the innovation in developed countries and therefore it is marginally valid.

The new concept which emerged from the experience is that technical progress and innovation in technology result from a global *interactive* and *incremental* process. In this process, the development and progress in technology are operated mainly inside the enterprises, with the compulsory pre-existence of an appropriate environment on the scale of large geographic areas (typically, at least, on the scale of an average-sized country) .

To a large extent, the quality of this interactive and incremental system determines the flux and the quality of the technical progress and innovation.

The most important parameters for effectiveness of such a system are:

- the quality of the human resources
- the activities developed
- the information available
- the amount and the rate of exchange of information between the three above parameters (this element being frequently a determining step in the whole innovative process).

The latter scheme for the innovation and progress in technology obviously implies, among other conditions, that the human resources in the enterprises are capable of taking their share, at their respective levels of qualification and skills, in the progress of the production techniques and of the technology.

Therefore, it is of paramount importance that the education given to the human resources in the enterprises make them capable of receiving, understanding, transforming scientific and technical information.

Technology Training: Building a Consistent and Effective Training Scheme, Through a Problem-Solving Approach to Industrial Problems

The final aim of the training is to produce human resources capable of

- receiving
- understanding
- transforming
- using for production scientific and technical information.

To meet these requirements, three questions shall be answered first, before building and implementing a training scheme in technology.

These three questions are: WHERE, WHEN, and HOW.

Where

Where is the easiest question to answer.

Whereas the first two conditions (RECEIVING and UNDERSTANDING scientific and technical information) may of course be met in the formal, initial education system, the third one (TRANSFORMING the scientific and technical information for production) may be properly answered inside the production systems. However, the condition for efficiently transforming the scientific and technical information in the enterprises requires trained personnel, in the education system, to consistently integrate the steps for receiving and understanding scientific and technical information.

In other words, the main expected output is that the education system provides not only scientific and technical "KNOW" and a little "KNOW-HOW," but, above all, gives the person appropriate intellectual tools and learning methods, so that the individual will be personally able to adjust his level of knowledge to the progress of the science and the techniques.

When

The second question, WHEN, calls for a slightly more detailed response. Indeed, none of the steps involved in the education in technology may be implemented in a strictly limited period of time.

Of course the initial, formal education system shall create the major part of background knowledge enabling the recipient capable of further continuing adjustment and of proper use for the enterprises. This process however spans the duration of professional life.

On the other hand, it is clear that the people involved in enterprises are increasingly less available for further learning and also, physiologically, less receptive to the content of an additional training.

If human resources are properly managed, this general adverse trend may be obviated, to some extent, in the enterprises. Although this limitation is a fact, the progresses in science and technology make unavoidable the implementation of continuing education and training in technologies. This up-dating process of both knowledge and know-how is one of the most interesting opportunities open to the enterprises, for carrying out effective and rewarding education of their human resources. It is one of the most successful approaches for simultaneously upgrading skills and dedication of human resources.

How

The third question raised, for technology training, is: HOW.

The above two questions WHERE and WHEN were quite preliminary. The main issue is indeed the implementation mode of the education in technology.

Training and Education in Technology are by no means extemporaneous processes, as soon as they go beyond the apprenticeship of repetitive operations.

Although the purpose of this short contribution is not to report or discuss the methods in education, let us remember here that an effective education system in Technology shall make the recipient able to assimilate three types of knowledge, the "know-what," the "know-who," and the "know how:"

- the "know-what," accessible for instance from data bases, reflects almost instantly the state of the art on given topics or techniques.
- the "know-who" responds to the question "who is doing what, and where is it done. This point is crucial as it tells *where* , geographically and thematically, the best potential partners are located for discussion.
- the "know-how" is the translation of the theoretical knowledge into productive actions in the enterprises, taking into account the information provided by the "know-what" and the "know-who" steps.

Outputs of Effective Training in Technology

The expected result of an effective integration of the three steps "know-what," "know-who," "know-how" is that the benefiting human resources contribute to the competitiveness of the enterprise, by bringing the following additional inputs:

- reducing the gap between quality of the work produced and the expected quality
- succeeding in the implementation of new equipment, techniques, processes
- enhancing the professional flexibility of the human work force
- promoting, in the enterprise, the concept that the future of the enterprise depends on the efforts of each member to improve his skills.
- developing the concept that the members of an enterprise can reveal and develop their personal capabilities and also, *simultaneously* , a better professional service.

At this point, it is important to accept the idea that Education and Training, especially in Technology , brings significant improvements compared with the old-styled Training Within Industry system. In the latter system, it was thought that a person having enough intellectual potential might learn from the surrounding human resources, and thereby reach the maximum level of productivity at work. When the concept emerged of a specific education including initial and continuing education, it was believed that the recipient would be able to rapidly reach its maximum level of productivity. In other words, the idea was that time was just exchanged with money (the training cost) with no final difference in level, but an earlier best performance" of the human resource.

Actually, all indications now available show that properly conducted education leads the human resources to a higher level of productivity than formerly reached through the TWI (Training Within Industry). However, reaching this (higher) maximum level of productivity through education takes about as long as reaching the accessible (low) level of productivity through TWI.

Thus, what is obtained from the expenses in education is actually not time but *productivity*.

Whilst increasingly, the managers of the enterprises understand the interest of specific education (be it "adjustment" or "continuing") in enterprises, legal and financial regulations were established in many countries as incentives to boost the continuing education in technology. For instance, the option taken in France twenty years ago was to ease the fiscal charges on the expenses of the enterprises when dedicated to professional education of their human resources. As a result, for instance, 39% of the human resources from the French companies had a training/education period in the year 1991, 10% up from about 35% two years before. It is obvious that this increase paralleled the increase of the economic competition on the world market: this is the clear illustration that the managers of enterprises become more and more aware of the interest of investing in human professional capabilities.

Thus, as indicated at the beginning of the present discussion, the need for education of human resources in technology stems from the need of an increased competitivity of enterprises.

In this context, however, it is very important to understand also that educating the people is only a part of the solution, although essential. Simultaneously, surrounding economic and legal systems shall exist to promote the best use of the "well trained" human resources.

V. Keeping the Training System On-Line with the Technological Changes

Human resources in the enterprises are continuously interacting with specialised systems which "feed" them with the new developments of technology.

Such an approach, which ultimately brings modern technologies into the enterprises and upgrades the skills of the staff, implies consistent and permanent interactions of the enterprises with three levels which complement each other.

The first level brings "INFORMATION:"

It implies the connection with data bases, the continuing use of specialised journals and the organised access to specialised books, in the technological domains relevant and of interest to the "products" of the enterprises.

The second level brings "TECHNICAL ASSISTANCE:"

In other words, it corresponds to the help brought by experienced people in fully operational techniques. This level calls for interactions with various sources of external technical expertise and know-how. This external expertise will, in principle, be available from technical schools, from vocational training units or schools and/or regional or national centres dedicated to the task of providing, or selling, such technical assistance.

The third level involves INTERACTIONS WITH THE RESEARCH UNITS:

The goal here is to make the human resources in the enterprises aware of the "trends" in research, and, initially, of the most recent theoretical and practical advances in their fields of expertise. The ideal scheme is to fertilise the inside of the enterprises through joint projects with research scientists. The most effective approach is contracts for research and development, or at least "loans" of researchers to enterprises—for a while—from Universities or from Agencies.

The above described approach for Education and Training in Technology has been implemented in early industrialised countries. Its effective implementation in new industrialised countries sometimes raises problems linked to the economic and industrial network, to the education system, and above all to a specific difference between the respective levels of development of the entrepreneurial sector and of the educational sector.

Indeed, in new industrialised countries, the economic and industrial system is generally oriented towards the production of items necessary to the every day life of the citizens. The technological content of such production is, statistically, low to moderate, with some exceptions. Therefore, such production usually requires a moderate education in technology, and this is based mainly on the large availability of manpower at low cost. In addition, part of the items are sometimes produced under foreign licenses with a moderate pressure towards further technological improvements.

On the other hand, in new industrialised countries, the education system, be it the initial or the continuing education system, usually reaches much faster than the economic system a level of development comparable to that of developed countries, and it is based on the use of the most advanced technologies.

As a result, frequent discrepancies are observed between the actual level of the human resources produced by the education system and the level of the technologies actually used in the enterprises. This situation is typical of industrialising countries and it still existed a few decades ago in some parts of Western Europe. This situation is now observed in new industrialised countries, and it is expected that this imbalance will be reduced gradually.

It is the quality and the effectiveness of the technology-oriented training system in these countries that finally, determines today the attrition rate of this imbalance.

Partnerships in Training Through National and International Networking

Mr. Jeff Gunningham
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1. Introduction

One of the Higher Colleges of Technology's (HCT) key strategic themes is to create a world class vocational education and training system in the United Arab Emirates. In order to achieve this, we need to continuously compare ourselves with the best in the world through viewing best practice and via benchmarking. One of the most effective means of achieving this is through education/business partnerships.

Already, many OECD countries have recognised the strategic value of partnerships and are utilising them to the full in developing the potential of their education and training systems.

The significance of partnerships as a world-wide phenomenon is obvious in the following comment made in June, 1992, by Tom Alexander, the OECD's Director for Education, Employment and Social Affairs :

> The world 'partnership' movement has come of age: partnerships have become central to education systems, and their messages reverberate across the international scene.

Partnerships are viewed by the HCT as a key operational strategy and this is the same for similar organisations around the world who regard partnerships as an important means of establishing a vocational education and training service which is more diverse and competitive.

In Australia, for example, there is a growing number of educational organisations (schools, TAFE, Universities) making a very definite commitment to the concept of partnerships as a strategic platform for running their business. Indeed, many of these organisations often refer to "partnerships" in their strategic plans, marketing information, annual reports and so on. I feel sure, however, that the majority of these organisations would agree that, in order to attract successful partnerships, it takes more than a few words in a glossy brochure.

For this reason, I will be placing a lot of emphasis today on the means by which you establish the optimum environment for nurturing successful partnerships in training. I will also illustrate, through specific examples, how these partnerships can assist in maximising the use of limited resources. The potential for international partnerships will also feature in my presentation. To begin with, however, I will briefly outline some of the benefits of partnerships in training and describe the types of partnerships that I have been involved with in Australia and elsewhere.

2. Benefits of Partnerships in Training

The challenge of establishing partnerships is not easy. It does take a great deal of time and there is a need for patience, for compromise, and for people to view issues from a different perspective, and to be able to adapt to changing circumstances.

There are, of course, many benefits to be gained from partnerships in training and these advantages are there, not just for educational organisations and industry, but also for the community at large. These benefits include:

- Efficient/effective utilisation of training resources and expertise regardless of whether they are located within the public sector or private enterprises. A key mechanism for sharing best practice.
- Provision of relevant training which matches the requirements of industry and can also be recognised externally.
- Partnerships have the potential to recognise all competencies in a training situation, particularly those acquired through experiential learning.
- Real and tangible benefits for the wider community.
- Local partnership initiatives are picked up in other locations, both domestic and overseas. They promote new training markets and allow access to a larger client base.
- Responds to the challenges of operating in a deregulated and open training market.
- Stimulates innovation in training delivery by bringing together different technologies and approaches to form new training products.
- Mechanism which responds to the corporate view of a growing number of "enlightened" companies.
- Mechanism which supports the concept of "collaborative individualism", an essential survival technique in the open training market being developed in vocational education and training systems around the world.
- Successful partnerships breed further partnerships. I can guarantee it! It's what industry needs. It's what training providers need to do, and partnerships will be supported and encouraged by Government.

Also, there is nothing to be scared of in establishing partnerships. For example, colleges should not be over concerned about losing control or risking people's jobs through partnerships. Indeed, if you consider the performance of Karratha College (Western Australia) between 1987 and 1991 after it became involved in partnerships:

- Programme activity increased 43% in the four-year period.
- Staff workloads (academic) were, on average, 40% higher than TAFE lecturers anywhere in Australia.
- In 1991, 30% of the college's recurrent income came from non-State Government sources.
- What this means is, that the Cost-to-the-State of running Karratha College in 1991 was some 26% less (real terms) than what it was in 1987.
- Over the four-year period, partnerships brought in around $2.5 million in non-Government funding to pump prime new initiatives, provide staff and equipment, contribute to capital works, etc..

What transpired at Karratha was a dramatic shift in culture which resulted in the organisation becoming much more externally focused. Slowly but surely, the mindset started to shift from one where partnerships were seen as threatening, to one where people actively sought all sorts of external strategic alliances that would add value to the college's core business.

So there really is something very potent in this concoction we call "Partnerships in Training"!

3. Types of Partnerships

Definition

Partnerships can take a variety of forms and can involve various parties, but the underlying purpose of the partnership is to optimise the use of limited resources, avoid overlap or duplication of effort, and to provide outcomes which are mutually beneficial. The relationship is more than the usual commercial arrangement between a provider of services and a customer—it's a genuine partnership where value is added to the operations of all participants. In other words, it's a win-win situation or an added value synergy.

Needless to say, definitions abound when you start to consider the various types of partnership that are starting to emerge amongst Western business enterprises. Essentially, these are forms of external networks which often carry the title "strategic alliance" or "strategic network." One such definition is the one put forward by Ausindustry in describing its Business Network Programme:

> Networking involves co-operation in an area of strategic business activity among three or more firms in the medium to long term, for the purpose of achieving mutually beneficial objectives. Ausindustry, "Business Network Programme," 1994

When it comes to education, Boot and Evans describe a partnership in a more straightforward way as :

> Partnership is where both parties establish a sense of worth and contribute in equal measure to a joint venture. Boot and Evans, "Partnership in Education and Change," 1990

In the UK, the Government has a major programme entitled "Education Business Partnerships" which focuses on young people and defines the partnership as:

> ...a joint venture between employers and the education services in a local community. It has a formal agreement committing the partners to work together to improve the education and employment opportunities of young people.... 'Business in the Community, "Education Business Partnerships," 1993

In Australia, the Federal Government appears to be moving in a similar direction to the UK through the establishment of local industry-education network committees whose primary function is to promote and facilitate partnerships between education institutions and businesses.

Characteristics

Another way of defining a partnership is to describe the characteristics which partnerships exhibit. These characteristics are useful in assessing[25] the effectiveness of a partnership which fits my initial definition :

- clear and common goals
- willingness to share resources, expertise and experiences

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[25] Participants interested in the evaluation of training partnerships are referred to the work o Chris Marsden, Head of Group Community Affairs, the British Petroleum Company p.l.c., London, UK.

- catalysts, facilitators and visionaries
- formal agreement on project management
- flexibility with regard to changing circumstances
- clear and sustained outcomes from training
- recognition of training outcomes and skills
- open communication and consultation
- working relationships are "institutionalised"

The work of Alan Davies and Stewart Haase from the Southern Cross University in Lismore, Australia, provides an interesting contrast of those factors perceived to be fostering successful partnerships. Davies and Haase[26] have carried out some interesting research on a variety of partnership projects and the Southern Cross University is one of the leading Australian universities involved in partnerships. Some of their observations relating to successful partnerships include :

- basing programmes on an analysis of industry needs
- trust and understanding between the partners
- development of formal contracts between the partners
- involvement of industry in all phases of the process

An analysis of one particular partnership (regarded as successful, eventually), revealed that major issues arose because of:

- the lack of a written contract
- the lack of clear boundaries affecting the perceptions of roles and tasks
- poor communication between and within the two organisations
- the lack of a steering committee to provide continuity and ownership within each organisation

Clear similarity exists with the partnership characteristics outlined earlier.

Possibly the most important ingredient for success in training partnerships is trust, mutual respect and understanding. But as Davies and Haase have shown, success will only occur when the strong trust relationship is supported by a written understanding of the mutual roles and responsibilities. Training partnerships, like other types of relationships, require some rules and regulations in order to stay friends!

4. Maximising Use of Scarce Resources

The most significant benefit of a partnership in training is gaining the ability to utilise all training resources and expertise regardless of locality and ownership. In this context, I am referring to training resources and/or expertise located in the public sector VET system, Industry, Universities, or private providers of training.

Need for autonomy

The means by which you achieve this collaboration will be covered in the next section of the paper. However, there is one overarching factor which is worth highlighting here; namely, that organisations (and their representatives) wishing to participate in a partnership in training for the purpose of optimising the use of limited resources must have the capacity to negotiate head-to-head with the potential partner and be capable of taking decisions. Industry, in particular, does not wish to spend significant amounts of time discussing the terms of a partnership to find later that the real negotiations will take place at a higher level and with a different person.

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[26] "Factors Fostering Co-operative Education", 1994.

It is this ability to make decisions locally that has allowed organisations such as Karratha College[27] to flourish as a consequence of various partnership in training initiatives. Indeed, the College itself is an organisation established through a partnership with its community (including industry) which over the years has resulted in partnerships becoming the main strategic platform for its development.

Karratha College is a Statutory Authority established under legislation (Colleges Act, 1980) and governed by a Council (Statutory Board). It does not report to any overarching bureaucracy, it is truly autonomous. What this means is that decision making resides in the community and community input is crucial to the decisions taken—and for partnerships, this is an extremely important operating principle.

The success of such colleges as Karratha has been recognised by the Western Australian (WA) Government, so much so that all TAFE colleges became Statutory Authorities earlier this year following the proclamation of the new VET Act. WA now has an integrated autonomous college network where the emphasis is on local control within a framework of state-wide quality. Indeed, as the Minister[28] (Norman Moore, MLC) stated at the time.

> I am confident the new college system will result in unprecedented co-operation in the vocational education and training sector, achieve economies of scale, and allow many benefits of an integrated system to be shared by students, industry and the community.

Examples in Vocational Education and Training

The following examples of partnerships in training have been gleaned from my time in running Karratha College in the Pilbara region of WA and then the Central Metropolitan College of TAFE (CMC) in Perth. In each case, there was a strong emphasis on making the most of limited resources. The examples are :

- A Skills Extension Programme with Woodside Offshore Petroleum which utilises Computer Managed Learning to deliver trade courses to workers on the North Rankin A Gas Platform, situated some 130 kilometres offshore from Karratha in the Indian Ocean.
- The WA Retail Skills Centre adjacent to the Perth Campus of CMC, now operating as a private provider of training (incorporated) but with a formal Partnership in Training agreement with CMC.
- CMC is also involved in a collaborative effort with World Geo-Science, the Australia Space Offices, CSIRO and Curtin University. This is the "Leeuwin Centre" facility in Floreat Park which is involved in remote sensing research and development.
- The design, development and delivery (in partnership) of the innovative Certificate in Supervision. The first course in Australia to receive State accreditation and National registration on the basis of joint ownership between academia (Karratha and Hedland Colleges) and Industry (Chamber of Mines and Energy, WA). The participating companies being :

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[27] Swetman W and Gunningham J, "The Community College Model : An Exemplar Approach to Partnerships in Training", 1993.

[28] "Ministerial Statement on an Autonomous College Network for Western Australia", 1994.

Argyle Diamonds
BHP Iron Ore
Hamersley iron
Robe River Iron
Telfer Gold Mine
Woodside Offshore Petroleum

This initiative utilised the Integrated Training Model as the framework for development.

- CMC has a very exciting delivery partnership with Deakin University in technology management where the course is enterprise based and can be accessed 24 hours a day, 365 days via Computer Managed Learning.
  - A range of organisations are involved in this initiative, including Western Mining, the Water Authority, Worsley Alumina and ALCOA.
- In the Pilbara, a delivery partnership where college lecturer's and industry training personnel join forces in the presentation of modules from the National Metals curriculum for apprentices.
  - This is carried out in a mixture of locations including company training centres and utilising company training facilities and resources, all of this occurring under the auspices of Karratha College. This arrangement applies to Robe River Iron Associates, Hamersley Iron and Woodside Offshore Petroleum and again, is an initiative based on the concept of Integrated Training.
- Another exciting development involves the Water Authority of WA where CMC's Skills Development Centre has developed a range of fast track management and engineering courses which are delivered in partnership involving Water Authority staff and lecturers from CMC.
  - Then, at the end of 1994, the CEOs of the WA Department of Training and the Water Authority signed a Partnership in Training agreement which provides a strategic framework for the above plus a range of other activities, e.g., joint venturing in the commercial provision of training obtained through tendering.
- Under a franchising agreement with the Southern Cross University, CMC intends delivering professional education courses in clinical nursing.
  - Southern Cross University is a leading exponent of educational partnerships and has a range of activities with such organisations as Telecom, the Australian Army, NSW Department of Corrective Services, Department of Defence, and so on.
- With Qantas, CMC has established a joint venture travel training facility in Perth.

The establishment of major campus facilities in partnership with the major mining companies :

Hamersley Iron	Tom Price
	Paraburdoo
Robe River Iron	Wickham
	Pannawonica

Agreement from the Australian National Training Authority to fund $280,000 an international partnership between CMC, Regency Institute of TAFE (SA) and

Gwent Tertiary College (UK) for adapting the software package "Capability" for use by RPL practitioners in Australia.

Pilbara Video conferencing Project LIVENET)

- Two way video/two way audio satellite communications system linking Karratha, Tom Price, Paraburdoo and Perth.
- A thirteen-month trial utilising funds provided by :
  Hamersley Iron
  State Government
  Telecom
  DEET
  - A major catalyst in focusing attention on the use of video conferencing for delivering education and training to remote locations in WA which has now developed into a permanent state-wide network.
- Establishment of a "virtual campus" of CMC in conjunction with the Department of Land Administration involving flexible delivery of accredited courses on site and utilising local expertise and resources to supplement the training. Again, Integrated Training in action.

5. Achieving Synergy

Natural Part of Business

In order to achieve synergy in partnerships, a great deal of effort will need to be expended in establishing an optimum environment. If you achieve this, you will find partnerships in training moving from being single projects or the periphery of an organisation to become a series of specific activities which form a natural part of everyday business. Ensuring partnerships in training become a natural part of your business is a very important point[29]. Indeed, there are many organisations around the world that view partnerships as an essential part of their day-to-day activities.

British Telecom Inc. is one such company as is indicated in the following comment from its Chairman, Iain Vallance :

> It is crucial for industry and for BT that we approach the business of building quality partnerships with education as an integral part of our day-to-day activity. In other words, as part of business as usual.

This commitment is also found in other parts of British Telecom. BT Education Services for example, which acts as a national focal point for partnership activity, made the following comment in a recent edition of the European Education Magazine:

> In the 1990s, we find that partnerships between business and education has become a byword in management circles and that making an effective contribution to education is enshrined increasingly in company policy.

If you look also at the amazing work of Ricardo Semler in transforming the fortunes of Semco/SA in Brazil, you will find that a great deal of his time was spent ensuring that processes/procedures aimed at changing the company became a natural part of the business.

If you accept the partnerships approach as a natural way of doing business, then it follows that creating the optimum environment for partnerships is as much to do with the culture and ethos of an organisation (private or public) as it is to do with anything else.

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[29] Marsden C, "Partnership: A Normal Part of Doing Business", British Petroleum Company p.l.c., 1992.

It is as much to do with people as it has to do with process and the way people perform is very much dependent on the organisation's culture and the way it is set up. In this sense, partnerships in training is a useful means of shaping an organisation in terms of strategy, structure and culture.

Key Issues

There is a number of excellent publications available[30] which outline what is required to make the partnership work. Whilst there is some variance in the range of issues identified by these authors there is also a great deal of similarity. This close correlation also extends to my own observations as to the key issues which require consideration in establishing the optimum environment for successful partnerships in training—they are:

- choose your partners carefully
- ensure partnerships become a natural part of business
- effective communication links within your own organisation and with your partner
- flat management structures
- commitment from industry to change traditional role
- understanding your partner's business
- flexibility in industrial award conditions
- spreading the expertise in partnerships
- expanding your resource base through strategic alliances
- being aware of the value to industry of "accreditation"
- establishing mechanisms for promoting and developing partnerships
- begin small, build on successful practice

You will note that previous sections dealing with the benefits and characteristics of partnerships also help to highlight issues which will influence the degree of synergy achieved.

6. Potential for International Partnerships

Practitioners in Australia

Earlier in the paper, I outlined some examples of partnerships in training involving a range of organisations. Most of these examples related to domestic partnerships although many of the organisations mentioned are also active on the international scene, e.g. the Regency Institute of TAFE (SA), Water Authority of WA, British Petroleum Company (BP), etc..

These are representative of the type of organisations using partnerships in a strategic way in order to add value to their core business. Indeed, if you consider a company such as BP, you will find them active in partnerships throughout the world and consistently using such comments as :

"community partners add value"

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[30] Limerick D and Cunnington B, "Managing the New Organisation : A Blueprint for Networks and Strategic Alliances", 1993.
OECD, "Schools and Business : A New Partnership", 1992
Holland A, "Making Industry Competent : University Industry Partnerships", 1994
Business in the Community, "Education Business Partnerships", 1993

"involvement opens doors"

"partnership protects business"

Needless to say, there is a growing number of organisations in Australia who are becoming active in partnerships in training on the international scene. In addition to the ones already mentioned, others worth noting are :

- The Curriculum and Customised Training Network (CCTN), an umbrella organisation representing the WA TAFE system overseas. CCTN uses partnerships as part of its marketing approach, although most activities are of a traditional kind involving commercial contracts. However, in servicing these contracts, it is the networking capacity of CCTN that brings partnerships to the forefront. Most States and Territories have similar organisations representing the VET sector in international markets.
    - Some examples of CCTN activities overseas includes :
    - Vietnam Land Management System Project; a joint venture between the Vietnamese Government, the Department of Land Administration, Curtin University and CCTN.
    - Iranian Mining Fellowship Programme; an international training partnership involving WA TAFE colleges (through CCTN) and Curtin University.
    - CCTN participation in the ongoing development (in partnership with Malaysian Government) of Kolej TAFE in Seremban.
    - In association with KPMG, the CCTN is becoming involved in training and related consultancy services throughout Indonesia.

These examples clearly illustrate the strength of a network such as CCTN in facilitating training partnerships and alliances. Through this network, the TAFE system in WA is able to offer international clients a comprehensive range of customised training products and services, including curriculum development, corporate training, and multi-media production plus access to a fully networked flexible learning system.

- SAGRIC International in Adelaide is similar to CCTN but has a wider brief to serve the requirements of a number of SA Government departments. A major partnership project that SAGRIC is currently managing is the Polytechnic Linkages Programme aimed at establishing long term strategic and operational relationships between TAFE colleges in Australia and Polytechnics in Indonesia.
- The Partnerships in Training National Network was formed in Melbourne in November, 1991, by a core group of educators and industry representatives who were involved in training partnerships.
    - The Network expanded its links and was able to give an opportunity for comparing experiences at the first Partnerships in Training National Network Conference held in Melbourne in March/April, 1992. The success of this conference prompted the 1993 Learning Partnership Conference in Sydney, and then in 1995, the Brisbane Partnerships in Training Conference.
    - The three State based education foundations—the Queensland Tertiary Education Foundation; the New South Wales Education and Training Foundation; and the Victorian Education Foundation —endorsed the concept of a national network of training practitioners; a self supporting

  network where the notion of true partnership with real benefit to all partners is recognised. The three foundations sponsor these partnership conferences.
  - Although the Network's primary focus has been partnerships within Australia, many of the organisations involved have strong international linkages.
- The Dusseldorp Skills Forum in Sydney also promotes the principles of partnerships and highlights best practice. The Forum was the co-sponsor of the 1993 Learning Partnerships Conference in Sydney and has extensive international connections, particularly through its involvement with the Work Skills Olympic competition.
- The Industry/Education Forum in WA helps to develop practical partnerships between educators and industrialists. Although broad in its approach, it runs a range of interesting events including lunch-time seminars which are a useful networking mechanism.
- In early 1995, the Australian Institute of Management in WA launched a new series of programmes entitled "Strategies for Success in Asia—Managing Partnerships, Joint Ventures and Alliances in Asia". Using a case study approach, the programme provides valuable insight in managing partnerships in the burgeoning Asia region.

International Partnership Network

The International Partnership Network (IPN) commenced in 1992 and is administered by the Centre for Education and Industry at the University of Warwick in England. It has several hundred members spanning some 24 countries across the world, the objectives being :

- to establish a network of interested organisations and individuals, and to create a database of information and materials on education/industry collaboration
- to undertake research and case-study writing within the area of education-business collaboration
- to organise a programme of conferences and seminars

The IPN publishes "Circuit," a useful bulletin describing current partnership activities in various countries. Another informative publication is the IPN Directory of Members which lists partnership practitioners along with their programmes and areas of interest. There is also easy access to the IPN database via facsimile or Internet.

The IPN's second international conference[31] took place in Paris between 30 June and 2 July, 1994. Approximately 450 delegates from 28 countries attended the conference entitled "Innovation Through Partnership : The International Challenge". The aim of exchanging information and spreading leading-edge practice was facilitated by the presentation of nearly 100 workshops under five main themes :

- Technological Change
- Innovation in Primary, Secondary and Higher Education
- Economic and Social Regeneration of Communities

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[31] A report on the conference proceedings is available from the University of Warwick, fax : 0015 44 203 524330, email: ceran@warwick.ac.uk.

- Return on Investment
- International Dimension

FORCE

Formation Continue En Europe[32] (FORCE) is an initiative of the European Union. FORCE seeks to influence the structure and content of continuing vocational training and to raise awareness in European Union companies—particularly small and medium-sized companies—of their capacity to cope with change and innovation. The central concern of FORCE is that training provision should be demand-led, and that partnerships should be formulated with that focus in mind.

FORCE was established in 1991, and from the start, projects have involved trans-national partnerships driven by the needs of training users, companies or groups of companies and also trade unions and local or sectoral employer organisations. The FORCE programme comprises a network of more than 700 projects involving some 5,000 partners of which 3,500 are companies. A significant feature of the FORCE programme is that 70 per cent of the companies are small companies, employing 100 or fewer employees.

FORCE seeks to bring together new initiatives, ideas, partnerships and networks, and to promote new approaches to enhancing quality, increasing competitiveness and widening training opportunities. The hallmark of FORCE projects is the commitment to partnership, which often involves companies and their work forces developing projects in association with the key players in Europe's vocational training infrastructure.

FORCE projects have produced a range of training materials (including distance learning materials) which are of value to the VET sector across the world.

Growth Areas

In terms of partnerships in training, significant potential exists in the VET markets of such places as Australasia, SE Asia and the Gulf Region. In all cases, I am talking about using partnerships to deliver high quality, innovative training which responds to new niche markets. This can be achieved by forming strategic alliances or partnerships between key VET practitioners overseas (mainly the UK, Australia and Europe) and their counterparts in the UAE.

The demand for good quality training products which respond to niche markets in SE Asia, for example, has been highlighted by the National Training Board in NTB Network[33]. The article indicates that the traditional suppliers of education to SE Asia (universities and polytechnics) are struggling to satisfy demand, specifically from those countries with a growing demand for skilled labour. New niche markets are appearing and servicing these markets often depends on partnerships being formed between host governments, enterprises and training providers.

The NTB article also emphasises the link between labour force training and the success of enterprises in tendering for projects or service delivery. Consequently, education and the export of training products is a cornerstone of trading relationships in SE Asia. This provides an ideal opportunity for the VET sector to join forces with those enterprises attempting to win business in this part of the world. The opportunity is there and it appears to be significant if you consider the following comment by the NTB:

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[32] Information provided by the FORCE UK Co-ordination Unit, Sheffield, England.

[33] Swanson D, "Australian Education in South-East Asia : Innovative Partnerships", 1994.

> With annual growth rates of between 8 and 9 percent the demand for skilled labour in S.E. Asia is high and shows no sign of abating. Areas where the demand for skilled labour is especially high include infrastructure sectors: utilities, transport and building and construction, although information management, telecommunication and bio-technology are emerging as 'sunrise' industries.

Based on my discussions with industry in the UAE over the past eight months, I would suggest that the potential for partnerships in training in the Gulf Region would be similar if not greater than SE Asia.

7. Conclusion

Hopefully, this paper[34] has demonstrated that partnerships in training have a great deal to offer academia and industry, both here and overseas. It's certainly not easy to establish partnerships and it does require a great deal of effort from all parties. It takes time and there is nothing to be gained from fast tracking or quick fix solutions.

It is important that all parties see themselves as truly participative partners. You will also need to establish a high degree of trust between potential partners and you will need to surround yourself with people with the same values and corporate goals.

But most of all, it is mutual respect and understanding which will ensure an ongoing and successful partnership in training. If you manage to achieve all of this, the returns to you and your organisation will be plentiful.

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[34] Based on a presentation made at the "Partnerships in Training" IIR Conference, Sydney, February, 1995.

The Dual Community—Training Technicians and Business Involvement: An International Perspective

Dr. Gert Loose
Adviser to the President
Oman Vocational Training Authority

1. Introduction

How can we secure the effectiveness of our training systems in the future? What kind of training concept should be designed, implemented and further developed which can assist us in promoting the prosperity of the Gulf region?

This conference has rightfully addressed the impact of technological change on national development. The Higher Colleges of Technology are at the forefront of technological training for the United Arab Emirates. Training the highly-skilled and upgrading technological skills for the work force is at the centre of the dominant role which technology has in national development. This article attempts to offer some guidelines on how the technical colleges can exploit the dynamics of change which are inherent in technology and which have, at the same time, to be tied up with the base of all training efforts, i.e. with the community of business and industry at the college location.

Global technological development and local attachment with business and industry are the two main parameters between which technician type training has to be conceived. The work of technicians is, on the one side, close to the dynamics of technological development and, on the other side—with its practical component—closely integrated in local business and industry. The place of the technician in the manpower structure can be marked as follows:

- Professionals
- Technicians and Middle Management
- Skilled Craftsmen
- Unskilled Workers

Technicians have to rely on professionals on the one side and on skilled craftsmen on the other side of a system of interconnected occupational levels. Being on an elevated level of this system, they will partly work as technologists, partly as assistant engineers, and partly in middle management.

Primarily, it is the function of technical colleges to train technicians but the close linkages with the business and industry community extend this target group: the technical college should serve the more demanding manpower requirements of its community, ranging from technician training to short term courses.

The basic concept of global technological development and local attachment with business and industry should guide any college planning process. It has therefore been further detailed here in all the aspects of creating a successful college programmeme from defining the objectives to operating the single programme. The considerations regarding the basic concept of the college constitute the phase of *pre-planning. Strategic planning* is then the process of mapping out all the details in following the dual community approach and *operational planning* is detailing the operational aspects of the strategic plan.

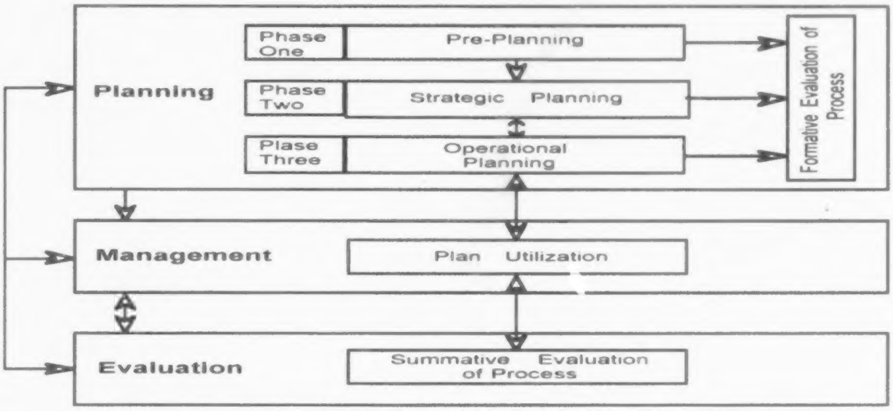
Planning
Phase One
Pre-Planning
Phase Two
Strategic Planning
Plase Three
Operational Planning
Formative Evaluation of Process
Management
Plan Utilization
Evaluation
Summative Evaluation of Process

Figure 1: Comprehensive Planning Process for Technical Colleges

Again, a technical college must incorporate planning parameters of its environment regarding contents and operation. Hence, an assessment of (world-wide) technological development and potential local ties with business and industry has to be part of the planning process. A model for such a planning process is presented below.

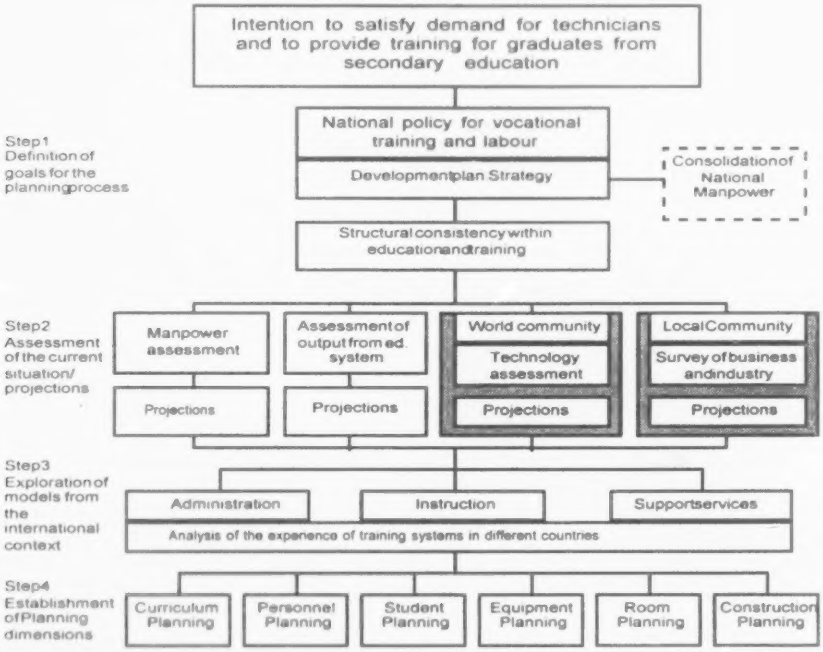
Intention to satisfy demand for technicians and to provide training for graduates from secondary education
Step1 Definition of goals for the planningprocess
National policy for vocational training and labour
Developmentplan Strategy
Consolidationof National Manpower
Structuralconsistencywithin educationandtraining
Step2 Assessment of the current situation/ projections
Manpower assessment
Projections
Assessmentof output from ed. system
Projections
World community
Technology assessment
Projections
LocalCommunity
Survey of business andindustry
Projections
Step3 Exploration of models from the international context
Administration
Instruction
Supportservices
Analysis of the experience of training systems in different countries
Step4 Establishment ofPlanning dimensions
Curriculum Planning
Personnel Planning
Student Planning
Equipment Planning
Room Planning
Construction Planning

Figure 2: Planning Process Technical Colleges

Interestingly the importance which the *local community* of business and industry has for the operation of technical colleges is matched by the importance the *world community* of technological development has for the instructional contents of the colleges. Therefore, it is a *dual-community* orientation which constitutes the core of an advanced concept of Higher Technical Colleges. This concept will be elaborated here.

2. The World Technological Community as a Reference for Programme Development

The international pathways of trade with high technology products have become so versatile that it is no longer possible to issue a national "certificate of origin" for computers which have been produced, for example, in the USA or in Germany. There is a world market for computer parts and the speed of development in this field as well as in related ones no longer observes national borders.

Even more excessively than the hardware component, the contentual aspect of information technology is burdened with a tremendous rate of change. The scope of this problem becomes visible when we consider the rate of change in the different types of information which we have to deal with.

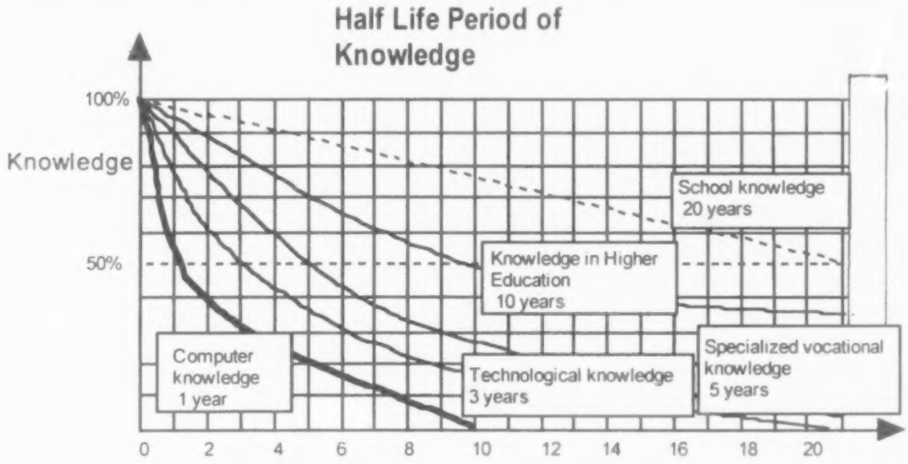

Figure 3: The Process of the Outdating of Knowledge

The adjustment of training to the rate of technological change is a paramount problem. The same globalisation which characterises today's technological development is also valid for the training programmes which are designed for coping with the technological change around us. Technical colleges from Singapore to Johannesburg and from New York to Abu Dhabi are confronted with the same problems of matching the fast changing requirements of high technology. We are members of a high-tech world community and beyond our national borders our high-tech programmes in training grant us access world-wide to coping with the most demanding skills. The challenge is paramount and there is no longer room for locally designed training solutions. Colleges in Singapore, New York and Abu Dhabi are working with the same technologies to achieve the same results in high-tech training.

In case we opt for "highly skilled" training, we must be aware that this world technological community with computers from Taiwan, high efficiency pumps from Denmark, navigation systems from the USA and medical devices for correcting bone deformations from Russia is our permanent source of reference for planning the contents of our training programmes. Consequently, we need to devise effective relationships to make sure that we are closely affiliated with technological advance. A sound research orientation, openness regarding the participation in international conferences and the willingness to engage in international co-operation with colleges in other countries: these are effective means for maintaining the ties with development initiatives in the various sectors of the world technological community.

International partnerships between technical colleges can provide effective assistance in maintaining top level training. As already indicated above there are certain lead countries for particular technologies and it would be advisable to closely monitor the respective developments. This can only be done through the commitment of the faculty towards their membership in the international technological community. Any resort to outdated practice will result in the loss of competitiveness and maladjustment regarding the actual skills needed in the labour market.

Furthermore the conveyance of high technology in the contents of training can only be effective with advanced learning technology which is appropriate for the requirements of our age. Worldwide semi-professional and middle management training has adopted certain structural elements to ascertain that recent insights from learning technology are incorporated. These structural elements pertain to methodological specifications as well as to the format of the learning concept. A brief description of the specifications and the format contain the following:

Emphasis on Middle Manpower

For industrialised and for newly industrialised countries alike, work force development will, in the future, focus on the highly skilled workers and on middle management because the less qualified work will increasingly be carried out in the low wage countries of Asia and Latin America. (The USA have coined the slogan of "high skill" or "low wage" to address the alternatives for future development of their work force.)

Furthermore, the number of people who are employed in production processes is sharply decreasing. Lean production and lean management as well as the emphasis on the distribution of goods, on insurance and on broker services: all these tendencies have led to the expansion of the middle manpower sector of the work force.

Emphasis on Practical Learning

Post secondary education programmes should offer highly skilled training in the technical and the commercial field. This type of education and training is terminal in nature. It usually does not extend into university education and its duration should not exceed three years.

For technician type training, this creates the conceptual problem that mature students (12th grade) without skill experience have to be qualified in handling complex skills within a fairly short time. Consequently, it cannot be the goal of post secondary training to focus on theoretical education. About 50% of the instructional time should be devoted to practical training.

Academic Trend in Work Content

It is an important trend in technical education today that the academic orientation of the contents is steadily increasing. The background of today's skills is becoming more and more sophisticated.

In many cases, complex theoretical interrelationships must be understood before the actual work can be carried out. Increasingly highly skilled competence can only become effective on the basis of knowledge regarding related technologies.

Emphasis on Extra-Functional Skills

The findings of research about reasons for losing a job have disclosed that the straight inability to perform the expected work accounts for only 25% of the cases at most. About 75% of the cases are due to deficits regarding interpersonal and extra functional skills. Hence, behaviour at the workplace and attitudes towards superiors, colleagues and subordinates are the most common reasons for failure on the job.

Therefore, it is important for students to become aware of the central meaning of extra functional skills and to become familiar with behavioural subconcepts such as punctuality and ability to accept orders. Part of the learning programme should specifically be geared towards learning extra functional skills.

Core Skills for Employment

The effective division of labour has increasingly become characteristic for the more demanding sector of the world of work. Quick and precise understanding between co-workers (partly even in an international context) has become a fundamental precondition of the work process.

Consequently, mastering a language (and if possible a world language) and possessing the right communication skills and skills in information technology and in the application of numbers are basic qualifications for today's world of work. In some contexts they are termed "key qualifications," in others "core skills."

Anticipatory Education

The rate of change in today's technologies renders it inappropriate to focus on learning for today's work processes because the students will have to master tomorrow's technologies. They therefore will have to learn to anticipate tomorrow's work situations and they have to acquire the basic competence of being able to adjust to skills which will be needed tomorrow.

Skill acquisition today has to encompass trends in the development of technologies and the anticipation of tomorrow's work processes. The central goal of training programmes can no longer be skill training making students fit for their entire working life. Instead they must become fit for coping with continuously changing work situations. In line with this policy, the concept of training has to adhere to tomorrow's technology orientation in the labour market.

Participatory Education

It has already been pointed out that the increasing division of work calls for other types of skills for successful performance in the world of work. The importance of communication skills has already been emphasised before, but beyond this, the ability is needed for working together in a team towards a common goal where formerly a single worker would carry out the necessary tasks.

Increasingly, a task has to be solved by a group of workers and students, therefore, have to learn to integrate their individual talents with the aim of carrying out more complex work. The "holistic" concept of work which generates its pride from the comprehensive work of the producer is no longer valid. The "participatory" concept of work is geared towards the achievement of a group of co-workers.

Self-DirectedLearning

Today's uncertainty regarding tomorrow's learning needs has implications regarding the style of learning which should be chosen. Since change dominates the development of our technological structures, tomorrow's agenda for learning cannot be disclosed today. Students have to acquire the sensitivity that they recognise their own learning needs and they have to design their own learning processes.

Self-directed learning offers the key to what we need to understand in the future. Learning resources are compiled for the self-directed use of the learner. Far beyond the potential for learning which is offered by traditional libraries the learning resources centre grants the student access to a self-directed search for the answers to key questions in our technological work environment.

Co-operation with the Private Sector

In advanced technical learning there has been the recognition that only through strong linkages with the private sector can preparation for employment gain sufficient quality. No simulation can replace the actual work environment and the workshop or office must therefore be incorporated in the training scheme.

On the basis of a taxonomy of learning experiences, duration and intensity of learning in the actual work environment can be designed according to the particular needs. This instrument is meant to provide the opportunity for gradual transition from isolated learning environments to the actual place of work.

Learning Concept Contains an In-Built System of Certification and of the Renewal Thereof

It is possible in the advancement of today's technologies that a certification of competence which has been issued at a given point in time will be outdated in the foreseeable future. Hence, it is very important to interlink the system of certification for skills with a subsystem which allows for the renewal of certifications once they have become outdated.

Unfortunately the rate of becoming outdated differs from technology to technology. It is rather slow in some areas of mechanical technology and exhibits probably the fastest pace in information technology. Consequently information regarding the renewal of certification has to be stated separately for each technological field including each achievement level within this field.

In addition to these specifications for an advanced learning concept for technical colleges the format for this concept needs to be detailed as follows:

Curriculum Outline (Scenario) is Provided for Each Learning "Element"

It is a frequent misconception that the teachers of self-directed learning groups are not in need of a curriculum which guides them in their daily work. On the contrary, monitoring a self-directed learning process encompasses not only the understanding about expected outcomes but the way in which the students can reach these outcomes has to be anticipated and stimuli have to be created regarding the starting points of learning processes.

Therefore the curriculum outline needed for a self-directed learning approach does not describe the teaching process. Instead a scenario of possible learning events is described and the possible starting points for self-directed learning are highlighted.

Student Guide is Provided for Each Learning "Element"

The need for self-directed learning has been emphasised, but in order to be successful this approach has to provide sufficient guidance for the learner. As part of an interlinked learning strategy the learner needs the assistance of the teacher but also of a student guide which serves as his reference in the difficult situation of defining and pursuing one's own learning process.

Students with different learning behaviour have to be assisted and while some students may naturally be inclined to pursue exploratory learning, others will be hesitant to encounter new areas of learning. The student guide has to provide the former with assurance that he or she is on the right way while the latter needs step by step assistance in progressing through new areas of knowledge, skill or attitude.

Learning Resources Package is Provided for Each Learning "Element"

Complete learning material has to include a learning resources package when self-directed learning is intended. Since the student has to pursue his or her own curriculum, it is mandatory to provide material which contains the pathways for successful learning in this area.

It is important that learning resources address all the senses (cognitive, affective and psychomotor) wherever applicable. The resources package should be wide enough to allow the individual learner to approach each subject according to his or her own mentality.

Criteria for the Assessment of Student Performance Are Provided

It is a common understanding that learning should be "successful". Yet, the understanding of what could be termed successful may vary widely. Primarily, learning outcomes must be open to a precise description, otherwise learning has not taken place.

Criteria for the assessment of student performance are needed to describe exactly what a student is supposed to know or to do after covering an area of learning (often called an "element"). Additionally a statement is needed regarding the actual situation in which this assessment takes place. This statement may vary depending on the specific socio-cultural environment.

The Assessment of Prior Experience is Incorporated in the Learning Concept

It is one of the strongest shortcomings of "static" concepts of learning that they only recognise learning which has taken place within their own design. Yet, it is common understanding that learning takes place in a variety of different life situations, both intended as well as not intended.

Experience gained from open learning situations is an important stepping stone for further learning. Non recognition of this experience leads to loss of motivation and frustration. It is therefore a characteristic of advanced learning strategies that they incorporate a mechanism for assessing and conveying credit for prior experience.

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"Compound" System of Learning Environments is Applied

The effectiveness of learning processes can be enforced depending on the environment in which they take place. Abstract mathematics are probably best learnt in the undisturbed quietness of a classroom while the assembly of a car engine can best be practised in a workshop. Hence, every type of learning requires a particular learning environment in order to optimise the learning outcomes.

Basically, in school and out of school learning environments have to be distinguished in technical education. Further differentiation is possible into school workshop, school lab and classroom on the one side and regional training centre, in-plant training centre and workshop on the other. Effective learning is based on an arrangement of these different learning environments to form a compound system.

1.	Learning concept emphasizes the importance of the middle manpower sector
2.	Learning concept emphasizes the importance of practical training (about 50% of the instructional time)
3.	Learning concept emphasizes the trend towards extending the academic foundation of work content
4.	Learning concept emphasizes the importance of extra-functional skills
5.	Learning concept emphasizes the need for core skills as part of preparation for employment
6.	Learning concept emphasizes the necessity of anticipatory education as part of preparation for employment
7.	Learning concept emphasizes the importance of participatory education as part of preparation for employment
8.	Learning concept emphasizes the importance of self-directed learning
9.	Learning concept emphasizes the importance of the cooperation with the private sector
10.	Learning Concept Contains an In-Built System of Renewal of Certification
11.	Curriculum outline (scenario) is provided for each learning "element"
12.	Student guide is provided for each learning "element"
13.	Learning resources package is provided for each learning "element"
14.	Criteria for the assessment of student performance are provided
15.	Prior experience is incorporated in learning concept
16.	"Compound" system of learning environments is applied

*For more details regarding the terms used in this matrix see the explanations in the paper.

Figure 4: Specifications of an Advanced Learning Concept for the Highly Skilled

Yet, these comprehensive specifications of the contents and methods of the learning process at technical colleges are only one of two important orientations for maintaining successful high tech training. The impact of the *world technological community* on the contents of training has its counterpart in the impact of the *local community* of business and industry on the operational structure of technical colleges. Or, in other words, our reference when designing programmes must be the implications of worldwide technological developments, but for successful delivery we need close ties and common operational planning with the local recipients of the graduates from our training programmes.

3. The Local Community of Business and Industry as a Reference for Operational Development

While the cosmopolitan orientation of a technical college has to rest with the ability of its faculty to create and promote contacts with colleagues in lead countries, it is necessary to establish a network of co-operation with business and industry in order to maintain optimal local ties.

Such a network has to encompass the national level promotion of co-operation with local business and industry, the local level operation through advisory committees of each college department and a continuous promotion of the system through a college co-ordinator. It is through close co-operation of these three components of this network that an optimal exchange of resources between the technical college and the local community of business and industry can be achieved.

A *National Advisory Council* has to give the necessary impact in co-operation between the college as a training provider and business and industry as the employers of graduates from the training programmes. Countrywide co-ordination of local activities is needed as well as the permanent promotion of a strategy which takes the technical college out of the classroom into business and industry and vice versa. Such a National Advisory Council should have the following functions:

- advise the national training authority regarding all aspects of an active attitude towards business and industry,
- inform the national training authority about main initiatives of business and industry regarding a successful co-operation,
- advise the national training authority regarding necessary change in the existing training programmes,
- inform the national training authority regarding new qualifications needed in business and industry and corresponding training programmes which should be implemented,
- advise the national training authority regarding rules and regulations which may further the co-operation with business and industry,
- advise the national training authority on measures of enhancing the national composition of the work force (for the Gulf region),
- advise the national training authority on how to encourage private training institutions in providing training which is needed,
- advise the national training authority on how to initiate the improvement of training facilities in business and industry,
- advise the national training authority regarding specific action to be taken by advisory committees or co-ordinators, in a specific regional context or with regard to a particular occupational area.

The suggested composition of the membership of the National Advisory Council has been stated in appendix 1. This council has a mostly representative function.

The actual liaison work on the local level has to be done by the advisory committees in the technical colleges. There should be a *Departmental Advisory Committee* for each department of the college and the functions of these committees should be as follows:

- advise the college department regarding opportunities for the training of students in the workplace,
- advise the college department regarding the implementation of the current curricula,
- advise the college department regarding the acquisition of equipment,
- advise the national training authority through the department and the college with respect to new qualifications needed and therefore new training programmes to be introduced,
- inform the college department about major technological innovations in the field,
- inform the college department regarding employment opportunities for the graduates,
- explore the possibilities of college departments offering assistance to business and industry and development of procedures stating how this could be done,
- initiate and partly organise activities which provide access of college staff to business and industry and vice versa,
- assist the co-ordinator in further developing and implementing activities which have been initiated.

A suggested composition of the membership for the Departmental Advisory Committee has been stated in Appendix 1. These advisory committees are the real interface between the technical college and the local community of business and industry.

Yet another component in the co-operation network is needed: the *college co-ordinator* for the co-operation with business and industry is the driving force needed to make this network functional. There must be at least one co-ordinator at each technical college. His functions should be as follows:

- organisation and supervision of internships in business and industry,
- creating in business and industry an awareness of the services of the college,
- establishing a close working relationship with the Chamber of Commerce,
- facilitating the establishing of advisory committees at the college,
- co-ordinating the implementation of on-the-job segments in training programmes.

A smooth interrelationship between the three components which have been described above is the key to successful co-operation with the community of business and industry. Such a successful co-operation can only be achieved through the establishment of an effective network as previously outlined. Extensive experience with co-operation networks in other countries have resulted in the following orientation marks:

- The advisory committee should indeed be purely advisory with no decision-making function involved.
- The advisory committee should be formally organised.
- All members of the advisory committee should be appointed by a proper authority.

- All individual members of the advisory committee should be appointed to definite terms.
- It is mandatory to have an advisory committee for each department of the college, the creation of one general advisory council for the whole institution has usually proven to be ineffective.
- A network involving all parts of the college in community work is needed including a constant promoter (co-ordinator) who sees to it that an active agenda of community involvement is pursued by all responsible staff at the college.
- The position for a college co-ordinator for the co-operation with business and industry has to be established at a high level in the staff hierarchy to enable the co-ordinator to direct the action of all personnel including department heads.

Yet co-operation with business and industry cannot be forced to happen through laws and regulations. Only through the spirit of voluntary co-operation can successful ties between the technical college and the private sector be established. Usually a mature understanding of the balance of interest in effective ties between the partners constitutes the basis. Any exertion of force would result in the formation of barriers between the college and its natural partners.

An effective outside agent in supporting this co-operation process can be the Chamber of Commerce. The Chambers have been established alongside the growing industrial communities in most countries. They have an overview over the type of industry based in their region. For the compilation of training related information, it is highly recommended that the Chambers establish their own training department. All relevant information should be compiled there, accessible to the co-ordinator at the college in order to facilitate his direct contacts with business and industry. Hence, the Chamber of Commerce and Industry could be a valuable partner of the college co-ordinator in his efforts to establish ties with business and industry.

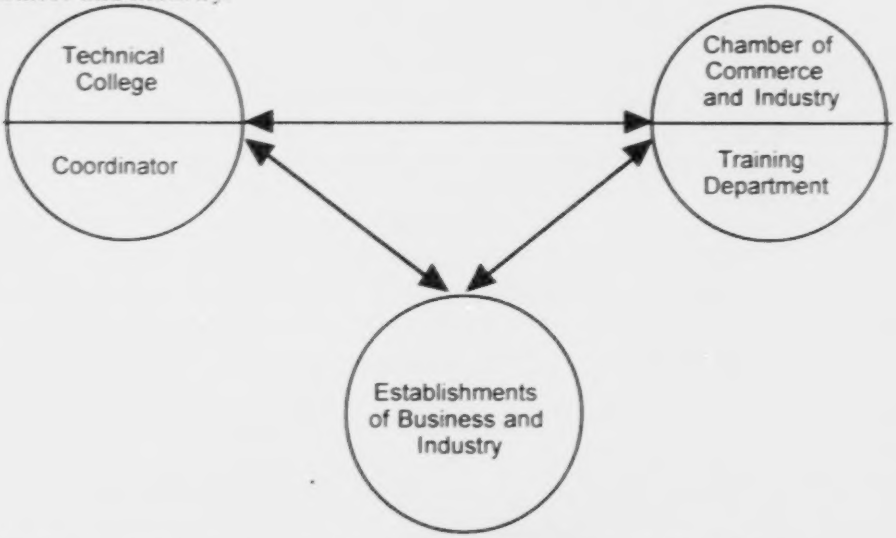
Technical College
Coordinator
Chamber of Commerce and Industry
Training Department
Establishments of Business and Industry

Figure 5: Co-operation between the College (Co-ordinator), the Chamber of Commerce and Industry (Training Department) and Establishments

of Business and Industry

Even with an effective co-operation network being set up by the national authority in charge of training and by the individual college, the logistics of a successful co-operation are intricate. Only through the voluntary co-operation of mature partners can the interests of the technical college and the local community of business and industry be merged.

4. The Impact of the Dual-Community Orientation on the Programme and the Operation of the Technical College

The analysis of technological development and the perception of business and industry at the college location; where is the impact felt of these dual communities on the programme and operation of the technical college? The occupational areas of operation of the college shall be appraised first before the actual process of the development of curricula is examined.

Defining Occupational Areas

Only on the basis of an assessment of the manpower needs of the local community can areas of training (clusters) be defined. These constitute "Departments" as the overriding organisational units of the college and "Specializations" forming the actual instructional programmes. It is assumed that a fully developed national network of technical colleges should be based on a national plan of all "Specializations" which are needed in the national economy.

From this national scheme the "Departments" and "Specializations" for the local planning of each individual college should be selected. By organising each institutional programme, a basic structure can be applied which distinguishes between the following categories :

- Core Departments (to be carried by all colleges),
- Diversified Departments (carrying all Specializations of a particular Department),
- Regional Emphasis Departments (to be established according to the specific manpower needs of a region).

From the experience of other countries it is suggested that technical colleges should in general carry the following Core Departments once they are developed to full capacity:

- Business and Administration.
- Mechanical Technology.
- Vehicle and Engine Technology.
- Electrical/Electronic Technology.
- Construction/Woodworking Technology.

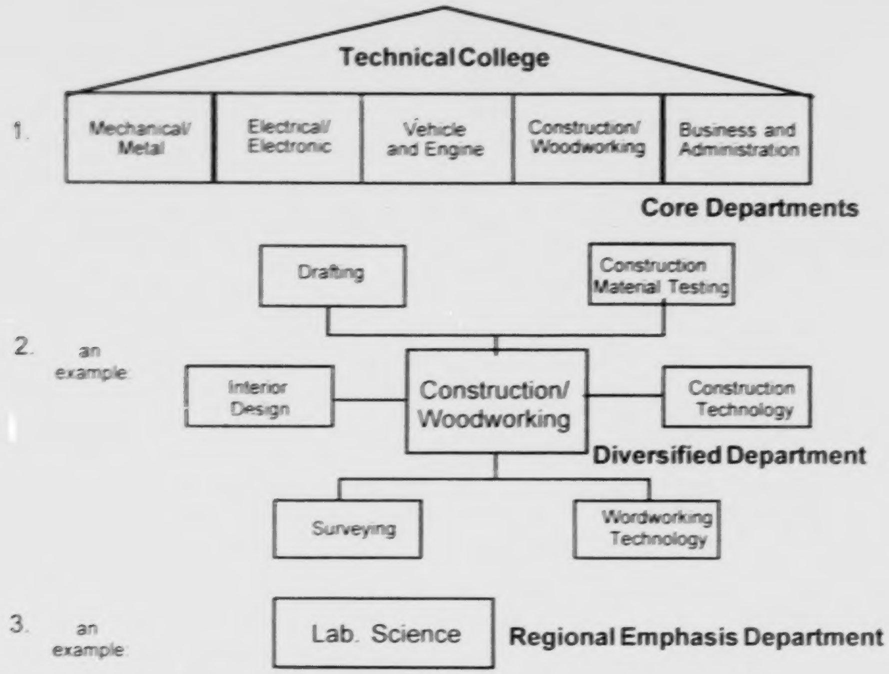
Technical College
1.
Mechanical/ Metal
Electrical/ Electronic
Vehicle and Engine
Construction/ Woodworking
Business and Administration
Core Departments
2. an example
Drafting
Construction Material Testing
Interior Design
Construction/ Woodworking
Construction Technology
Diversified Department
Surveying
Wordworking Technology
3. an example
Lab. Science
Regional Emphasis Department

Figure 6: The Structure of Departments and Specialisation's

It would be the intention to have the Core Departments represented in each technical college. Yet, it is neither possible nor necessary to accommodate all "Specializations" of a Core Department in each college. Instead "Specializations" have to be selected on the basis of the particular situation in the area.

However, *national demand* may call for the establishment of certain "Specializations" within a given Department and it may not be feasible to argue for a specific *local allocation*. An example for such a "Specialization" could be "Hospital Management" in the Department of "Business and Administration". In this case one college should be selected to carry *all* nationally relevant "Specializations" of the Department of "Business and Administration" (Diversified Department). This college should then assume a leading role in training for the particular field.

On the other hand there could be particular regional needs such as e.g. the training for laboratory assistants in the capital area or for agricultural specialists in a rural area. This reasoning should lead to the establishment of Regional Emphasis Departments—in this case for "Laboratory Science" in the capital area and for "Agricultural Technology" at a college in a rural environment.

Very careful planning is needed for the design of all these programmes, because the prospective students generally lack prior skill training experience and under these circumstances a duration of three years maximum is an extremely short time for the attainment of a technician level in training. Comprehensive fields of skill experience must be avoided and instead programmes must be "sandwiched" out of a component of basic skill training followed by a rather demanding component of technology in a particular field.

Within the broad field use of computers "Computer Technology" (Hardware) is an example for a programme which is based on a limited area of basic skills in connection with an attractive application in a demanding technological field.

Developing the Instructional Programme

Guidelines for designing the instructional programme and for teaching it have been developed further above. These guidelines have to be applied to the development of occupational profiles as the foundation of any training programme.

The occupational profile has to reflect the advanced technologies in the particular area and subsequently these technologies have to be adapted in the following stages of the process of curriculum development together with the guidelines regarding the format of teaching. Altogether, the stages of curriculum development are as follows:

design of the occupational profile,
development of a basic structure of programmes,
definition of core curricula,
determination of the timetable,
composition of the synopsis of curricula,
development of detailed curricula.

The detailed curricula should present the full range of technological competence at the college. They should also exhibit a high degree of implementation of out-of-college learning environments as an indicator for the involvement with the local community of business and industry. Finally the application of advanced learning approaches has also to be indicated in the detailed curriculum.

This is neither the place for a precise analysis of curriculum development nor can the establishment of a national plan for training be dealt with in detail. Yet, the target has been to design orientation marks for this part of the planning process for technical colleges and these orientation marks are closely related to the dual community of worldwide technological development and local attachment to the community of business and industry.

5. Conclusion and Outlook—The Dual Community Orientation of Technical Colleges

All technical colleges are confronted with the following two problems:

- maintaining up to date training programmes and
- maintaining sufficient ties with business and industry.

As an answer to these problems the world technological community and the local community of business and industry have been placed here in the context of college planning.

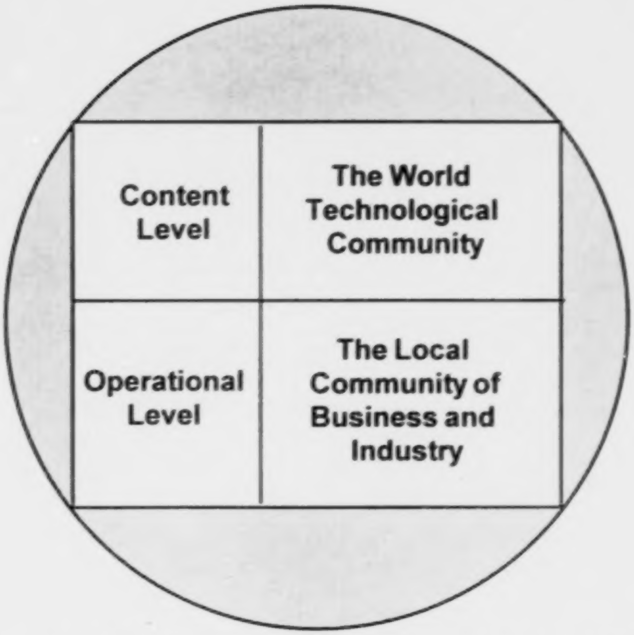
Content Level
The World Technological Community
Operational Level
The Local Community of Business and Industry

Figure 7: The Dual-Community Orientation of the Technical Colleges

Such a college planning process is not a one off endeavour. It needs constant updating. Careful reassessment of all aspects of the cosmopolitan technological orientation of the college has to go hand in hand with evaluating and improving the local ties with business and industry.

This has been referred to as a dual community orientation. This image of a dual community orientation should be clearly expressed when stating the mission of the technical colleges. Also, provision should be made for the enforcement of this orientation in order to secure quality training programmes.

Appendix 1

Suggested membership of the National Advisory Council:

- President of the national training authority
- Vice-President of the national training authority
- Representative of the national training authority*
- Principal of a training college*
- Principal of a technical centre*
- College Co-ordinator*
- Representative of the Ministry of Commerce*
- Four Representatives of business and industry*
- Representative of the Chamber of Commerce and Industry*

(*elected for two-year terms with one opportunity for reelection. The permanent members are for chairing the meetings.)

Suggested membership of the Departmental Advisory Committees:

- Principal of technical college or his representative (chairman),
- Departmental head of the particular occupational area,
- College co-ordinator.

- Representative from the instructional personnel in the particular occupational area,*
- Four Representatives from business or industry in the particular occupational area, *
- Representative of the local Chamber of Commerce and Industry (optional)*.

(*elected for two years terms with one opportunity for reelection, other members hold permanent appointment.)

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Strengthening Professional Pilot Education through Academic/Industry Collaboration

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Introduction

The existence of a gap between industry entry-level professional pilot needs and civilian "professional pilot" education/training has been widely reported. Industry needs fully qualified entry-level turbo-prop and turbojet airline pilots, but the old training programmes are continuing to educate/train pilots to the Federal Aviation Administration (FAA) specified minimum standard as listed under FAA Part 141. A recent Industry Advisory Committee report succinctly states the problem: "Students are not prepared to make the jump from traditional FAA 141 Commercial Pilot certification standards for a single pilot in a light twin aircraft to the cockpit of an airline turbojet operating in the professional environment."

There are several reasons for the gap between student performance and the skills required by the aviation industry: One is simply that few training programmes address the competencies expected of incoming professional pilots such as the operation of the "Glass Cockpit," "Flight Management Systems," "Auto-Flight," and transport category aircraft. Professional pilot education programmes too often stress individual contributions rather than managed group efforts. Yet, group efforts are the norm in the professional aviation industry. In order to meet these new requirements, higher levels of training devices than those normally associated with university type programmes are required.

High Fidelity simulators and Flight Training Devices (FTDs) are now available and the use of these devices can greatly enhance the effectiveness of training programmes by providing "jet transition" as well as experience flying the "glass cockpit" in a crew environment. The use of FTDs is being fostered by the FAA through AC 120-45A that provides for seven levels of training devices that can be used for both training and checking. In addition, the FAA has recently submitted a proposed Advisory Circular addressing the capabilities of Personal Computer Aviation Training Devices (PCATDs). As a result, full service programmes need a wide variety of training devices to include; Computer Based Training, PC-Aviation Training Devices, Flight Training Devices and Full Flight Simulators.

A New Curriculum Model

To address the skill and knowledge gap between traditional pilot education programmes and industry entry-level professional pilot requirements, Embry-Riddle Aeronautical University has introduced a new experience-based professional pilot education/training model with emphasis on academic/industry collaboration. The model attempts to close the gap by developing a full service "Simulation Centre" on campus to serve as the bridge between the two. The Centre will provide a viable mechanism for the University to facilitate academic industry collaboration.

The proposed educational model has its roots in the medical school/teaching hospital concept central to the education of physicians. In the medical model, student interns apply their classroom knowledge to real patients while "practising medicine." Similarly, professional pilot students can learn to "practice professional pilot skills" by flying in level D airline simulators with real world problems in a real world environment. The mission of the Centre, therefore, is to pair faculty and students with real industry partners and have them carry out real airline tasks in a real airline environment. The model has the twin goals of preparing competent entry-level airline pilots and contributing to the advancement of the state of professional airline pilot practices. Seamless integration of Centre activities with undergraduate students and the professional airline industry is a central feature of the effort.

Background

While training aids have been available in various forms for many years, the first FTD used on a large scale was the GAT Link Trainer. During the late seventies and early eighties a number of companies began producing "high fidelity" digital based FTDs and use of these trainers increased rapidly as flight schools and universities discovered many of the lessons that the airlines and the military already knew: That a training device is economical, safe and provides a better teaching and learning environment. FTDs have been traditionally used for instrument training, although some attempts have been made to use the devices for training issues such as judgement, CRM, and some initial pre-flying activities. Over time, it is safe to say that it has been empirically derived that training devices do in fact cause learning to occur and that the learning does transfer to the aeroplane.

Later in the seventies and early eighties personal computers (PC) became available, and developers soon identified the potential that a PC-based training device might have. In the 1980s, PC-based simulators, now known as PCATDs started to appear. A number of problems were associated with the early PC-based training devices, such as poor graphics, caused by the limited power of the computers at that time. However, as the speed of the computer chip increased, the capability and improvement of these devices markedly increased and in many cases now surpass the capability of the generic FTDs.

In the mid nineties full flight simulation training became available as part of an accredited degree aviation programme at Embry-Riddle Aeronautical University. The education/training model was a combined effort between the University and a number of traditional airline training organisations. The ground school or academic portion of the effort was conducted by the University and flight /simulator training by the training organisation. While initially an experiment, it quickly became evident that graduates of these degree programmes were technically capable of piloting transport category aircraft to specified levels of competency.

Past Experiences with the Model

Embry-Riddle Aeronautical University was quick to recognise the advantages of the experiential learning aspect of this model and moved to initiate real-world training agreements where possible. The University entered into formal agreements with a number of regional and major air carriers to provide opportunities for students who had completed FAA certification training through the Commercial, Instrument and Multi-Engine and had passed academic courses which include Advanced Systems and Total Resource Management. These programmes made it possible for "low time" students to take company and aircraft specific training as a part of their academic programme and to be eligible for employment as pilots upon graduation. Five of the more successful programmes are listed below:

Merlin Express—students spend a semester with the company and receive training in the Metroliner. They then return to campus to finish their degree and upon graduation are eligible for immediate flight officer employment. Over 30 students have been hired in the past three years and four of them have already upgraded to Captain.

United Airlines—This is the oldest flight intern/co-op programme on campus. Students spend a semester at United and must complete the normal pilot hire interview and screening procedure. Over 30 students have completed the programme and have been hired after graduation. Students go directly into the right seat of the 737 upon completion of training.

Continental Airlines—10 to 12 students every semester are given regular pre-hire interview and screen. 15 students have been hired out of this programme into the 1900D and ATR 72, four of them have already upgraded to Captain.

Atlantic Southeast Airlines (ASA)—29 students have been hired upon graduation since September 1996 to fly the ATR 72.

Five-phase Approach to Full Realisation of the Curriculum Model

Unfortunately, because of the expense and time involved in these "experiential learning models," relatively few students have been able to take advantage of the opportunity. Consequently, the University initiated a five-phase evolutionary approach to formalise the model on campus. Phase one started with an in-depth review of the intern/co-op experience discussed above, expanded discussions directly with the industry, as well as a modified cognitive task analysis effort for the professional pilot. Phase two was the actual curriculum development process directed at the specific requirements identified in Phase one. These requirements addressed all aspects of professional pilot training including undergraduate training (initial) for the university student as well as the non-university "contract" student, transition training and proficiency training. Phase three consisted of an agreement with FlightSafety International to locate at least two level D simulators on campus to address all three levels of training. Phase four and five are in the process of being implemented along parallel tracts. Phase four is the internal delivery of the curriculum to the undergraduate college student as a part of the initial professional pilot training curriculum. Phase five is the delivery of all phases of training; initial, transition and proficiency, to interested parties in the aviation industry.

As indicated above, the curriculum for each level of training has been reviewed and revised to take maximum advantage of a wide variety of training devices under close guidance and advice from our industry Advisory Council. The revised programme includes maximum use of the simulators at all levels coupled with increased emphasis on total resource management and decision making, as well as superior technical skills.

The new level D simulators are being equipped with Computer Aided Debriefing Stations (CADS), a device designed to aid in the CRM debriefing of pilots. This device developed by US Air and Embry-Riddle and funded by the FAA has the capability of recording and then playing back any segment of the training activity. The information provided includes a video of cockpit activity, instrumentation, and flight-path. To aid in debriefing, the instructor can mark the "tape " to identify specific issues and points of interest. Although originally designed and funded for CRM, the device will provide unique capabilities that go beyond the original intent. For example, it can be used to measure curriculum and instructional effectiveness.

The simulators are a critical element in the curricula because they provide the opportunity to expose students to experiences and technologies they will need when flying with a commuter, regional or major airline. Because airlines now focus on issues other than just a pilot's technical capability, aviation education must include topics that address airline corporate image, appropriate management skills, reading and writing and other general education topics. The revised programme includes maximum use of the simulators coupled with increased emphasis in these "new" areas of study.

The University

Of the 14,700 students enrolled at Embry-Riddle, approximately 4,300 under-graduates attend the Daytona Beach campus with another 1,500 at the Prescott campus. Undergraduate enrolment in Extended Campus programmes is 8,900 and nearly 6,300 students are enrolled in graduate programmes University-wide. Embry-Riddle's students represent all 50 states and more than 100 nations and the University offers associate and bachelor's degrees in 20 areas of aviation and aerospace studies and master's degrees in four disciplines. The University has the ideal environment for learning. It combines an impressive faculty with new state-of-the-art buildings, laboratories, classrooms and a diverse student population.

As indicated above, in addition to the two traditional residential campuses, Embry-Riddle serves the continuing education needs of the aviation industry through its Extended Campus, which includes a network of over 100 off-site education centres in the United States and Europe. The Extended Campus offers seminars, workshops and customised training and development programmes to military and civilian working adults through the Division of Continuing Education. The Embry-Riddle Language Institute helps non-English speaking aviation professionals and prospective students become more proficient in their listening, speaking, reading and writing skills. The Department of Independent Studies allows students to focus on learning as their schedules permit. Whether using computer-based training, video course work or satellite downlinks, working professionals have a vast array of flexible educational services from which to choose.

The Simulation Centre

The Embry-Riddle/FSI Simulation Centre is the key element in this new effort to close the gap and keep cost down. ERAU and FSI have joined together to provide training in "state-of-the-art" simulators on the Daytona Beach campus. A Beech 1900D Level D simulator and a Boeing 737-300/400 Level D simulator are being made available by FlightSafety in a unique joint venture. To house these devices a building with four simulator bays was constructed on the Daytona campus. These devices will be used by Junior and Senior level students as a means of introducing technologies and aircraft types that are commonly used by the commuter, regional and major airlines. Further, the simulators will provide an ideal platform for a capstone course which encompasses CRM, turbojet and airline transport training. During their junior and senior year, students will take advanced training in the Simulation Centre that will go well beyond that typically required in an undergraduate pilot training programme and, as an option, type ratings in both aircraft will be available. These courses are to be used to fully prepare the students to meet the demanding needs of the carriers. Often it is said that graduates of traditional training programmes, no matter how good they are, do not have the experience a well seasoned high time pilot. While this may be true, it can also be argued that a pilot with less time who has been taught to deal with the same situations that a more experienced pilot has "probably" seen may well be an even a better candidate for an entry level airline position, certainly with a potentially greater pay-back period.

The Simulation Centre concept was approved by the University administration in Spring, 1996. The building was constructed, the simulators went into production, a separate management/training organisation, called CATER, was formed to market and operate the simulators and the curriculum was developed. CATER works in close co-operation with the faculty to identify resources available as project personnel and to support the faculty with administrative tasks, hiring and supervision of instructional staff personnel, data collection, etc.

The Flight Officer Training Programme

The University's four year professional pilot college degree programme has been enhanced to include upper division flight courses in the both the Level D Beechcraft 1900 simulator and the Level D Boeing 737-300 simulator under the joint venture with FlightSafety International. A number of CRM "performance markers" have been developed as the central elements of this programme and are included in each certification training course. Each individual flight period contains a specific CRM topic or topics. Appropriate performance markers are outlined, and guidance for the evaluation of the student by the instructor is included. The instructor reviews the topic, conducts the pre-flight briefing on the topic, sets the scenario during the flight portion of the lesson, observes the student's behaviour relative to the identified performance markers, records their observations and facilitates a prompted-recall debrief.

In order to provide for meaningful practice of crew skills in an academic environment, the techniques used are developed from a teaching strategy known as co-operative learning (CL). The key components of CL are similar to CRM and include: positive interdependence, face-to-face promotive interaction, small group skills, individual accountability and group processing. This structured approach to team learning in the academic programme will reinforce the skills needed to be an effective cockpit crew member and will serve to make CRM training a totally integrated part of the Aeronautical Science degree programme.

This integrated approach, "CRM across the curriculum," will provide continual reinforcement of CRM and safety concepts and practices and should serve to reinforce the necessary expectation that CRM is the way of life of a professional aviator.

Programme Implementation

The programme is being implemented in several phases. The first phase involved the identification of the appropriate behavioural markers for each flight and academic course. These markers have been integrated into both the flight and academic programmes.

Phase two consisted of awareness training for the flight instructor staff and the academic faculty. This training includes the concepts of the programme, how to monitor and evaluate the appropriate performance markers effectively and effective pre-flight and post-flight briefing techniques. Assessment training is conducted to insure inter-rater reliability. This is an area of high concern due to the large number of flight instructors (approximately 125 to 150) and the extremely high turnover rate (50 to 60% annually). The faculty are being trained in the use of CL and CRM and this awareness training is also included as a part of the new-hire programme for flight instructors and faculty.

Phase three consists of integrating CRM components into the academic classes and flight courses along with the appropriate performance marker. Guidance will be given to the flight instructor on how to use the markers and a simple method of recalling performance will allow for a prompted-recall debrief. Every effort will be made to deliver the programme without appreciably increasing the instructors' workload. CL problems and exercises are grouped with certain performances in mind with the opportunity for group processing and evaluation at the end of the exercise.

Phase four will be the development of programme assessment tools that will allow for easy identification of effective performance with data that can be quickly entered into a computer database. Key behaviour will be evaluated on each stage check within the flight training programme.

Phase five will be the development of a recurrent training programme to provide continuous reinforcement of the programme at all levels. This programme will consist of semester long training sessions where specific topics, problems and solutions can be discussed.

Conclusions

To maximise the educational experience while keeping costs down, techniques that apply a structured approach to training need to be implemented. These techniques include an Instructional Design Process that builds on "learning styles" and "teaching styles" for both instructor and student while taking maximum advantage of training techniques and technology. As we move in this direction. It is understood that "Transfer of Training" is the objective, rather than high fidelity simulation.

To maximise training the use of a fully integrated curriculum that utilises all of the training technologies available should be used to ensure that each potential airline pilot is fully equipped to manage the flight deck of turbojet transport category aircraft. Further, training and education programmes must satisfy the needs of the airlines that are beyond the FAA's current minimum requirements. It is clear that technical proficiency alone will not meet the needs of the industry. Tomorrow's pilots will have to be capable of educating themselves, while adjusting to the corporate culture and working with a variety of personalities.

Using advanced technology, these goals can be met. Lessons learned from University and industry partnerships like Embry-Riddle and FSI will be an integral element, and perhaps ultimately all of the training can be completed in a training device with simulation used only for validation and checking. It can be argued that while that technology is available now, one major criterion is missing, "time at risk." One caution is urged - that while low time pilots can fly sophisticated simulators and aircraft quite well, programme the computer, manipulate the controls and follow a checklist if needed, their approach and attitude is quite different from that of the seasoned pilot. A student pilot in a simulator flying an approach to minimums or dealing with an emergency, such as an engine fire, probably does not have the same concerns as a well-seasoned pilot. Therefore, care must be taken to ensure that learning goes beyond the simple technical skills and addresses all relevant human aspects of the task in the real world environment.

The full service training facility with "state of the art" equipment and associated "soft skill" educational package now available at ERAU in partnership with FSI serves as a model for how pilot education and training will be done in the future. To develop the concept further, additional alliances are already being created between the university and a number of airlines to provide improved training and to contain costs to students.

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Modern Geomatics and National Development

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Introduction

Information technology is critical to national development. This paper will examine some of the major issues relating to this relationship by using the emerging field of geomatics as a specific example. First I would like to define briefly the two terms I am using. Geomatics is a collective term applied to what were previously independent fields of study such as cartography, photogrammetry and remote sensing, geodesy, GIS and other mapping sciences. Geomatics is defined as:

> ...a field of activities, which, using a systematic approach, integrates all the means used to acquire and manage spatial data required as part of scientific, administrative, legal and technical operations involved in the process of production and management of spatial information". (Canadian Institute of Geomatics, 1995)

This field is now dominated by computer, telecommunications and other related information technologies.

National development is more difficult to define. I would argue that it includes at least four key components:

- increased economic growth
- improved equity and the distribution of wealth and opportunity
- control by the people of their own destiny through participation in decision-making
- the achievement of qualitative transcendental values which in some instances can be equally, if not more important, than the other three components listed above. These values include issues relating to religious beliefs. There can be no national development in the Gulf region for example, without Islam, which is fundamental to national development.

National development cannot only be defined in quantitative terms and differs over both time and space. It is a dynamic concept and is best defined in terms of the aspirations and values of people in their own social context. Clearly different nations will put emphasis on different components of development at different times in their history. Development is a continuing process. Development is an optimistic term. It suggests progress and forward movement but for many parts of the world there is limited evidence that development, however defined, is taking place. In many nations of Africa, for example, the quality of life for the majority of people has been declining in both absolute and relative terms. Drought, civil wars, environmental degradation, government mismanagement, outside interference and unfair terms of trade have led to falling incomes, declines in health and education, increased unemployment and a general malaise. The

African Development Report of 1996 (African Development Bank, 1996) indicated for the first time in some years some signs of a recovery from crises but much remains to be done. In Africa, the very concept of *national* development is in dispute. The nation state, for a variety of reasons, has failed to bring about development and many authorities argue that action must take place at both the sub-national and the supra-national scales if real progress is to be made. Latin America, after what has been called the "lost decade" of the 1980s, is showing remarkable signs of economic recovery and growth. Macro-economic and political factors, such as the creation of NAFTA and MERCOSUR have revitalised trade and, despite temporary setbacks such as the peso crisis in Mexico, the rate of growth in Latin America is most impressive. Internal political and economic reform, such as has occurred in Brazil under the leadership of President Cardoso, has created a new climate for positive change but underlying structural problems, such as large imbalances in income between the rich and the poor, continue to remain a problem. Inflation has, however, been dramatically reduced and the situation is much improved, with investment flows correcting the situation prevalent at the end of the 1980s and early 1990s when the net capital flow was from the South to the North - the exact opposite of what is required for development.

In Asia the two most populous nations in the world, China and India, are showing remarkable growth with the performance of the Chinese economy being one of the most remarkable and sustained economic growth performances of the twentieth century, far out performing the so called "Japanese miracle" of the 1950s and 60s (Taylor, 1996). India's macro-economic indicators are impressive but they mask increasing internal disparities between the rich and the poor and even the current macro-economic situation gives cause for concern. Population growth continues to pose problems for both nations despite programmes on birth control. The enormous absolute numbers mean that even modest rates of population growth in percentage terms pose major problems, especially where the factors of production, such as arable land, are limited. In other parts of Asia, such as the so-called four "Asian tigers" — Korea, Taiwan, Hong Kong and Singapore — economic progress continues but for many nations rapid economic growth must take place simply to maintain the status quo. It can be argued that resource and land constraints added to population growth pose real limits to economic growth.

It is not surprising that, in these circumstances, the physical environment is coming under increasing pressure. The issues involved were well described in the *Brundtland Report* (WCED, 1987) which set the stage for the world conference on this topic held in Rio de Janeiro. The difference in perspective between North and South which emerged again in Rio is interesting and important. Environmental degradation by the people of many developing nations is not an act bred simply out of ignorance and greed but often out of desperation and the need for survival. To talk of development for many of Africa's peoples, for example, is incorrect—we are really dealing with the struggle to survive. Environmental problems cannot be divorced from development problems. Developing nations are being asked by industrial and post industrial societies to meet the costs of a development path before they have had the opportunity to experience the benefits. A major reason for concern is that the problems of environment cannot be isolated in space because national action or inaction often leads to impacts which are felt not only on national territory but on a regional, continental or even intercontinental scale. Although the environmental problems of surplus such as those of pollution by industrial societies are different from the environmental problems of poverty, there is an inexorable link between the two.

The same, of course, applies to many of the other problems facing developing nations. Development thinking tends to go in phases. It is fashionable these days to look for the solution of development problems at the national scale and internal "structural adjustment" is the remedy suggested by the World Bank. A major problem with structural adjustment programmes is that they tend to underestimate the importance of North-South relations in the development problematique. There are those who argue that the success of the "First World" has been built on the exploitation of the Third World and that this is continuing in new and more subtle ways long after the period of formal colonialism is over. Indeed, it has been argued that World Bank structural adjustment programmes are in themselves yet one more manifestation of First World influence.

Although these analytical perspectives are controversial, there is no doubt that relationships between the First and Third Worlds have been unequal for centuries and continue to be so today. An understanding of these relationships is critical to an understanding of the context of development.

Recent changes in the geopolitical scene make the situation even more complex. Dramatic changes have taken place in the "Second World"—the former Soviet Bloc. Almost overnight a revolutionary change has taken place in the relationships between the First and Second Worlds. It is not clear what the long term impact of this will be on Third World nations but there are already clear signs of change. It is likely that increasing portions of development assistance will be redefined and redirected and that commercial loans and private investment will also seek new outlets in the Second World rather than the Third. Technology transfer, overseas development assistance and private loans and investments are important elements in First World-Third World relationships. The Second World was a player in the equation and was, in fact, a competitor with the First World for influence in Third World countries, a competition that many Third World countries often used to their advantage. Recent events, have, however, changed all of this. The Second World is now a competitor with the Third World for First World attention.

Modern information technology, of which geomatics is a subset, is very much a First World technology. The utilisation of geomatics in a development context will depend upon the *ways* in which technology transfer takes place as much as upon the nature of the technologies themselves. If the First World finds new and more politically compelling outlets for its interests, the present nature and scale of that technology transfer may change. Thus, to understand the role of geomatics in national development, it is necessary to understand the challenges and context of development itself, which are constantly changing. This is not primarily a technical problem and technology transfer is not a purely technical problem. The appropriateness of the transfer process is as important as the appropriateness of the technology itself.

Appropriate technology is best defined as that most appropriate to the task. In some cases this will be the highest technology available; in others more modest solutions will be required. Appropriate technology is not always equated with simple technology. In all cases, however, the solution chosen must be appropriate to the development context in which it is to be applied. Here, technology is only one of a number of complex socio-economic and political factors to be considered. Education and training have a critical role to play in ensuring effective technology transfer and in ensuring that new technologies such as geomatics are useful to national development.

Geomatics and National Development in the Middle East

In 1997, two significant events took place in relation to geomatics and development in the Middle East. In February one of the most prestigious journals in the geomatics field, *GIS Europe*, published an edition with a special focus on the Middle East. Significantly, the keynote piece was not on technology itself but on the political and economic challenges facing the region. In an article entitled

> "Peace and Prosperity in the Balance," Alan George (George, 1997) concludes that, "The Middle East stands at a watershed. Pessimists fear that the region could be heading for another long round of instability and impoverisation (sic). Optimists insist that peace and prosperity are just around the corner. In reality the future is likely to hold a complex mix of elements from both views." (George, 1997:123)

He draws attention to the serious impact of the intransigence of Israel in stalling the peace process. Two of his observations are of particular interest. The first is that economic changes of a fundamental and positive nature are taking place which are having at least as great an impact on the region as the political and military dramas which capture the media headlines. The second is the great complexity and specificity of the regional picture.

The special issue goes on to consider the contributions which geomatics is making to national development by giving five specific examples: The work of Electricité du Liban in building a digital foundation for managing electric power lines in Beirut (Fry, 1997); the remarkable case of Qatar which is the first country in the world to set up a nation-wide GIS via a fibre optic network which by 1998 will see all 16 government agencies having linked access to public spatial data (Baumann, 1997); the work of the Centre for Environment and Development for the Arab Region and Europe (CEDARE) (Fry, 1997). CEDARE was founded in 1992 and its main sponsors are the Arab Fund for Economic and Social Development, UNDP and the Government of Egypt. The Centre has five main environmental topics: water resources management, land resources management, urbanisation and human settlements, marine and coastal zone management and industrialisation. A digital data base bank on each of these topics is being developed. One current project relates to the management of the Nubian Sandstone Aquifer, the main source of water for almost two million square kilometres of North East Africa; the use of geomatics in the archaeological exploration of the Pharos lighthouse of Alexandria, one of the seven wonders of the ancient world (Staudacher, 1997); and the first ever national land cover map of Dubai created by using satellite imagery and GIS (Hetherington, 1997). This information is of great importance to regional planning for environmental purposes of Dubai municipality.

The second event of significance to geomatics and national development was the holding of a key conference and series of workshops in Qatar in March, 1997.

This conference, entitled *GIS/GPS Conference '97*, was organised by the National GIS Steering Committee and the Centre for GIS of the State of Qatar and gave an excellent overview of the application of geomatics in several Middle Eastern countries. Qatar is amongst the leaders in the geomatics field and in 1992 won the Exemplary Systems in Government Award of the Urban and Regional Systems Association (URISA) from a leading private company in the GIS field, ESRI of the United States. The emphasis in Qatar is on the use of these new information technologies by government and a keynote address to the conference by Sheikh Ahmed Bin Hamad Al-Thani was on this theme (Al -Thani, 1997). 36 papers were given on GIS and GPS, two of the key aspects of modern geomatics, with examples from Egypt, Lebanon, Kuwait, Qatar, Jordan, Iran, Oman, Saudi Arabia, Abu Dhabi and Dubai showing the remarkable growth of the application of geomatics since its introduction to the region around 1990. The applications described covered a wide variety of topics from the environment to real estate.

Both Saudi Arabia and Egypt, as the two largest countries in the region, are increasing their use of geomatics technology rapidly. In 1996, the Saudi geomatics infrastructure was estimated at upwards of $3–4 billion and growing at the rate of $500 million per year. One analysis of the situation concludes:

> Today, the scope of geomatics activities in the Kingdom encompasses: strategic military applications, agricultural surveys, coastal studies, engineering, environmental studies, geomorphology, geology, land use analysis, urban planning, mineral exploration, rangeland resource assessment, sand control research (i.e. desertisation), water resource assessment, hydrographic studies, oil spill monitoring and planning for new highway development.
> (Department of Foreign Affairs and International Trade, Canada, 1997)

Although the consideration of geomatics applications has been of necessity brief, there is abundant and growing evidence of the importance of modern geomatics to national development in the region.

Challenges for Education and Training

Modern geomatics, as with most computer and information technologies, is an artefact of the industrial and post-industrial societies of North America and Europe. Prior to 1980, apart from a few research applications and exploratory projects, these technologies were not applied to any great extent in a developing nations context. In the Middle East, it has only been since 1990 that modern geomatics technologies have been effectively applied in the region.

In the initial introduction of the technologies, outside agencies and private companies are major players. Canadian companies have been particularly active. The Canadian geomatics industry exports between $250 and $300 million of technology and services annually, which represents approximately 25% of total industry revenues. Several Canadian firms have been active participants in the Middle East market for many years, in some cases dating back to the 1970s. The following sample list of activities and specific projects is illustrative of the types and scope of Canadian geomatics expertise which is being employed in the countries of the region:

- Nortech Geomatics Inc. has offices in both Oman and Yemen, from which they provide a range of specialised navigation, positioning and mapping services to the oil and gas industry and other clients in the region.

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- Terra Surveys Limited has extensive mapping experience in the Middle East, having conducted a major mapping programme for the entire country of United Arab Emirates, and is currently working on the digital mapping of the City of Riyadh, Saudi Arabia.
- Intermap Technologies (formerly Intera Information Technologies) has conducted a number of digital mapping and GIS consulting projects in Qatar.
- A group of companies led by S.L. Ross Environmental Research Limited conducted an assessment of the coastal environmental damage caused by a major oil spill in the Persian Gulf during the recent war in the Middle East.
- Marshall Macklin Monaghan Limited completed extensive surveys and mapping work in Saudi Arabia in conjunction with the development of urban infrastructure and transportation facilities.
- RADARSAT International provides data from Canada's first earth observation satellite, RADARSAT, to the countries of the region through local licensed distributors.
- MacDonald Dettwiler and Associates Ltd. established an Earth Observation satellite ground receiving station in Saudi Arabia in the 1980s and recently won a contract to upgrade the station to deal more effectively with optical imagery and also handle radar data from Canada's RADARSAT satellite.
- Canadian geomatics software companies, such as PCI Enterprises, TYDAC Research Inc. and Universal Systems Ltd., have sold their image processing and GIS software products in several Middle East countries. (Kennedy, 1997)

These contributions have led to some impressive results but if modern geomatics, or for that matter, any of the new information technologies, is to make a lasting and sustainable contribution to development in the region, the need for indigenous control of these technologies is of paramount importance. Vendors either deliver a product on a consulting basis or deliver "turn-key" systems which sometimes include a training component. This training component is, however, usually short term and is restricted to the operation of the system. Vendors will maintain and update these systems for a price if required but the use of the system is then in the hands of the purchaser. This assumes that the purchaser has a clear idea of why the system will be useful and how it will be applied to development problems. This demands a considerable base of indigenous knowledge and expertise.

Despite the examples I have given earlier, with the possible exception of Qatar, the applications of modern geomatics to national development are still marginal and if the considerable potential of these technologies is to be realised then indigenous scientists and decision-makers must gain a greater degree of knowledge and control. Education and training are key elements involved.

What strategies should be used in this respect? One approach is to look at what is being done in other nations to see if any of these are applicable to the situation in the Gulf region. Experience in post industrial societies such as Canada or the United States is interesting but I feel that the approaches used by other countries such as China, India, Malaysia or Mexico may be of greater relevance. In the final analysis, however, the solution used must be specific to the needs and situation of each country concerned.

In the Gulf region, the main agencies involved in the application of modern geomatics are likely to be agencies of national governments and, to a lesser although growing extent, the private sector. What is needed is a two pronged strategy–short term approaches to meet immediate needs and a longer term and continuing education development strategy. The approach used should be applications driven with the potential contribution of geomatics to the problems of national socio-economic development being a factor in determining how education and training are themselves developed.

There are two elements in the introduction of modern geomatics to national development. The first is an understanding by senior decision-makers of the potential of geomatics techniques and their application to national development. This strategic decision demands a knowledge base and a firm commitment to the importance of this field. Without this high level commitment it is unlikely that the introduction of these technologies will succeed. An example of a state where leadership has made this commitment in the region is Qatar. Under the leadership of HH Sheikh Hamad Bin Khalifa Al-Thani, the Emir of the State of Qatar, a National GIS Steering Committee has been established together with a Centre for GIS. The Ministry of Municipal Affairs and Agriculture has played a leading role and in a recent message the Minister and the Under-secretary commented:

> GIS/GPS technologies are making a tremendous impact on the world and Qatar is no exception. The potential contribution of GIS/GPS technology to the sound and prosperous management of our land, resources, utilities and well-being are boundless. During the past six years, Qatar has implemented a completely integrated nation-wide GIS, servicing the needs of both government and citizens alike... Many of us in Qatar have exceedingly benefited from these technologies and wish to share its blessing with others. (Bin Saeed Al-Khayarin and Bin Saad Al-Kuwari, 1997)

This statement was made in March to the participants in the GIS/GPS Conference '97 mentioned earlier. This was followed by a keynote address made to the Conference by Sheikh Ahmed Bin Hamad Al-Thani who, as Qatar's Minister of Municipal Affairs and Agriculture from 1992 to 1996, pioneered GIS within the State of Qatar and was appointed the first Chairman of the National GIS Steering Committee. His paper states:

> Government leaders need up-to-date and comprehensive information to make right decisions. Enhancing well being of citizens is the responsibility of every Government decision-maker. Making the right decision is directly associated with having the right information at the right time. The decision-maker's problem today is not the decision-making process but getting to the right information to make the decision. In this day and age, access to the right information at the right time is as important as having access to other infrastructure services. In Qatar we have anticipated this and are using Geographic Information Systems (GIS) as core technology for providing this service. (Bin Hamad Al-Thani, 1997)

Sheikh Bin Hamad Al-Thani is often referred to as the "GIS champion of the Arab World" and such leadership and enthusiasm are important elements in building the knowledge required. In educational terms, under his leadership two major conferences and workshops have been held in Qatar and such conferences and workshops are important educational strategies to increase access and to familiarise the leadership of the region with the key issues and opportunities. There are numerous international conferences and workshops held on geomatics each year but conferences specific to the needs of the Gulf region and with direct involvement of indigenous experts are of special importance.

At GIS/GPS Conference '97 two workshops were held—one on an Introduction to Geographic Positioning Systems and the other on the use of the Internet. This latter workshop is of particular interest to education. Increasingly, the Internet and the World Wide Web are major sources of both information on geomatics and on education and training in geomatics. A good educational strategy for any nation is to ensure increased access and availability to the World Wide Web. The new technologies can themselves be used to teach and learn about these technologies. This will increase awareness of decision-makers on the importance and potential of geomatics and increase the dissemination of the results of conferences and workshops. Only a few hundred people attended the GIS/GPS Conference '97 but thousands could access the conference through the Web. My own knowledge of the conference came through accessing the Web site from thousands of miles away. I did not, in fact, attend in person.

Although the role of distance education and learning should not be exaggerated, it is clear that the new technologies have very great potential. At present access to information is unequal and many parts of the world, especially in Africa, have very limited access to the Internet and the Web. Access to computers is also limited. At one end of the scale there is the United States with 330 computers per 1000 people and Canada with 228 per thousand. At the other end of the scale there are countries like India with one per thousand and others where the ratio is much lower than that. A key educational strategy is to increase computer access and computer literacy.

Language is also important in this respect. English is the language of the information era and this restricts the use of new technologies. What is needed is not only software developed in other languages but also information on the World Wide Web in those languages. There is an Arabic version of Windows software but geomatics software in Arabic is almost non-existent. The same applies to information on the Web in Arabic although it is increasing. Educational policies relating to language are critical for the information era. For Arabic speaking nations a regional approach may be required to ensure a greater Arabic presence on the Web. Countries like China are already writing their own software in Mandarin. Written information in the form of journals and magazines on geomatics in indigenous languages is also required. China, for example, translates articles from other countries into Mandarin and distributes them through its own journals which sell for a reasonable cost and in local currency.

Decision-makers must also be prepared to accept and promote access to and sharing of information and the socio-political changes that may result. Some years ago I was involved in the introduction of geomatics technology to the Survey of India. The use of the new systems was severely limited by the fact that much of the data required to make the systems useful was classified and therefore not available. Without the willingness to make information available little can be achieved. Here, the politics of national development of the role of information in society are key. Technology is not value free and modern geomatics is particularly demanding in terms of sharing information, some of which is considered sensitive or of military significance. Modern geomatics played a key role in the Gulf War, especially remote sensed imagery, GPS and digital terrain models and military uses continue to grow. More effective use of geomatics in national development requires a greater degree of peace and stability in the region.

Overseas training and education in geomatics is another strategy which can be used in the short term to familiarise decision-makers with potential applications. Short term courses and visits to leading nations in the field, such as Canada, can be of real value. For the Gulf region, a short term visit to Qatar would be of special value, especially to allow an assessment of the transferability of the Qatar model (Coiner, 1997). There is also value in visiting countries such as Mexico, India, China and Malaysia. South-South transfer of technology may in some instances be preferable and more effective than North-South transfer which currently dominates the process.

Decision-makers in positions of importance and influence are important to the education strategies required. Decision-makers need not be experts on the technological side of geomatics. They must understand the technologies and their strengths and weaknesses and they also need to understand the applications and management aspects which are largely non-technical challenges. This demands understanding of the socio-economic context of national development and how geomatics technologies can be adapted to particular situations. Too often the foreign expert or the foreign firm presents technological solutions with an insufficient understanding of the societal context in which these are to be applied. In the worst cases these can be solutions in search of a problem and can result in "scratching where the people do not itch!"

In addition to the education of the decision-makers, there is the challenge of developing indigenous technological expertise in geomatics. This is required at various levels. It is unlikely, in the Gulf region, at least in the short term, that the Chinese solution of developing indigenous software and hardware can be followed. There will be a dependence on systems development elsewhere. What is required is technological expertise to carry out a full and thorough assessment of the capabilities of the systems being acquired. Here Mexico's experience is instructive. In 1991/92, the Mexican Government took a decision rapidly to modernise the geomatics capability of the national statistical and mapping agency, INEGI. A $20 million contract was put out to contract and four major bids were received. Using indigenous experts, Mexico did a very thorough and detailed analysis of each of the bids. Two independent international experts were hired to advise on what *kinds* of analysis should be done but the actual analysis and benchmarking was done by teams of indigenous experts working independently and comparing the results of their analyses (Taylor, 1993). Even small nations require a cadre of people with the expertise. Many of the Mexican experts referred to above received their university education in Canada, the United States and Europe and, in the short term, there may be little alternative to sending promising young scholars overseas for education in rapidly evolving technological fields like geomatics but many of the Mexicans involved returned to Mexico to develop programmes in their own universities. The country which has used this approach to best effect is China (Taylor, 1993). Selected young scholars were sent abroad and then brought back to act as focal points in the two key state laboratories which China has established in the geomatics field (Laboratory for Information Engineering in Surveying, Mapping and Remote Sensing in Wuhan, and Laboratory of Resource and Environment Information Systems in

Beijing. China also makes effective and systematic use of leading international experts by inviting them to give lectures and workshops. These often involve six hours of lectures per day and these are videotaped for future use with Chinese voice-over translations. Maximum knowledge extraction is the order of the day!

National development demands an indigenous university and research capability in information technologies of which modern geomatics is a part. For small nations this may require co-operation with like-minded neighbours or new forms of international partnerships. Knowledge based industries are the wave of the future and capital investment in the human and physical infrastructure required will pay enormous dividends. Malaysia, for example, has developed an ambitious plan to transform itself from a low wage developing nation to a leader in information technology through the creation of a Multi-media Super Corridor (Bramham, 1997).

The Gulf region will benefit enormously from linkage with two major under sea fibre optic cables: FLAG (Fibre Optic Link Around the Globe), due to be completed in 1997 and which will have transmission speeds of 5 gigabytes per second; and the even more ambitious SEA-ME-WE 3 with double this speed, the completion of which is planned for 1999. The United Arab Emirates will be terminal points for both of these cable systems making them a major node on the world's information network (Marouney, 1997).

Once the decision-makers have decided to utilise geomatics technologies and the appropriate choices of which technologies to be used have been made, human resources to operate and maintain these systems are required. It is a well established fact that the costs of implementing and staffing a modern geomatics systems can be at least double the costs of acquiring the hardware and software. Colleges of higher technology have an important role to play in this respect. In the geomatics field, Qatar, for example, has recently introduced the first GIS Technology Programme in the Faculty of Technology of the University of Qatar (Rose, 1997). This is a two and a half year programme based on the GIS technician programme developed at Sir Sandford Fleming College in Canada.

Education in this field, as in all fields of information technology, is very challenging because of the tremendous speed of technological change. The half life of knowledge in the computer field is now less than a year meaning that much of what is taught may be out of date well before students graduate. There is a temptation to teach the use of particular systems but this approach has many drawbacks and a better approach is to teach basic geomatics principles which can be applied independently of any particular system.

The use of geomatics systems is perhaps best taught in-house and on the job. Here, vendor training can be useful but only in the short term. In-house training expertise is required and one approach is for individual agencies or firms to enter into a contractual agreement with a local educational institution to provide such training *in situ*. Increasing use is now also being made of multi-media training resources and geographical location is no longer the barrier it once was in the information era. Electronic classrooms and virtual universities which can deliver courses anywhere in the world are now very much a reality. In technical education and, for that matter, in all forms of education, we are experiencing a major change. As Eli Noam (1995) has argued, the concept of educational institutions as the focal points for information and learning to which students flocked is changing as the direction and nature of information flows change. Rather than people moving to the information, the information is coming in increasing volumes to the people. Modern geomatics is an excellent example of how such information flows are important to national development.

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English for Technology

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Introduction

Specific design and delivery of English language courses can enable low English proficiency non-native speakers to participate in technical training. This paper describes expanding programmes at Embry-Riddle Aeronautical University since 1994, which address differing language demands during pilot training, the model used and test preparation.

Paper

In the world of English language teaching there are many acronyms: ES, TEFL, ESP, TOEFL, TOEIC. And then there's TENOR.

TENOR is a particularly widespread phenomenon. Its not, as you may think the language taught to Luciano Pavarotti or Placido Domingo. TENOR is found in elementary school classrooms, in colleges, in intensive university English programmes and in countries where English is the mother tongue, or where English is a lingua franca, and where it is neither of those. TENOR is the Teaching of English for No Obvious Reason.

TENOR is where English poetry and scientific ideas, for example, are included as subject matter in an English curriculum but no-one's really sure why. TENOR is when there's neither rhyme nor reason. There's no denying that poetry, literature and science teaching have a place, an educational role, but any such inclusion in vocational and technical programmes, to avoid waste of educational resources, must be justified, specified and validated.

From a practitioner's point of view, I want to suggest a way that may avoid misdirected English teaching in technical institutions. How do you determine what should be included in an English teaching curriculum?

As early as 1975, Dr. J. A. van Ek had identified a useful curriculum for high-schools for the Council of Europe. It stated what learners should be able to do in their newly acquired language (whether English or another language). The teaching target was for learners to become competent communicators. While teaching methods were not overly stipulated, teaching outcomes were. This was called "The Threshold Level."

This direction was not an isolated one. Earlier industrial language training units in the United Kingdom and immigrant/migrant English teaching in Australia had also identified comprehensive performance skills that their learners were to acquire.

Like these practical programmes, the Threshold Level described the things a learner should be able to do in English, the likely contacts, the predicted activities, the settings, the roles and the topics within 14 areas.

Accomplishment of these language performance goals laid the basis for later language development, or rather, paved the way to pass through the threshold, through the doorway, on the way to the rest of one's life. Examples of language uses, called "functions," 75 in all, were greeting, expressing agreement, denying, seeking permission, requesting others to do something.

Now from the mid-70s, let's move to the mid-90s, to a post-Threshold Level situation that existed in the aeronautical science/flight courses at Embry-Riddle University in Daytona Beach, Florida. Similar situations may exist in other technical and non-technical educational and training settings. Perhaps the course design steps we have taken at Embry-Riddle can suggest better use of teachers and a better use of students' time.

The Embry-Riddle situation springs from the mandated use of English as a global language of aviation. Due to English language deficiencies, many of our international students, when compared to American students, were taking longer to complete the flight courses, with lower grades and higher expenses. At worst, some international students were unable to complete the course successfully. Because of their proven capacity to succeed in non-flight courses and in order to enhance the safety of the Embry-Riddle flight operation, we introduced language screening and preparatory English classes for all international flight students. Our setting in a technical university is the example for the activities, roles, topics and the contacts.

In these classes we focus on having our students demonstrate their ability to perform specific flight training tasks—we aim to be pre-emptive about equipping them with the language needed for successful participation in their concurrent or subsequent training course.

Early flight training demands ability to handle predictable and quite formulaic and repetitive tasks, by listening and speaking in English. These are normally performed at a rapid rate and determine what happens in later stages of the flight. We recognise these in the familiar pilot/controller exchanges.

In these communications there is often low or even zero tolerance for error or delay in both receiving and imparting information. Other aspects of flight training demand similarly advanced reading skills in order to perform successfully on the job. We deliver the needed language in a just-in-time manner to ensure relevancy to the flight trainee's training progress.

Through the range of flight courses the university offers, we have identified four accompanying courses which deliver the English required for success. These English courses correspond to the developing sophistication during a pilot's training: an introductory pre-training English course, English training to begin a private pilot's license, English for a commercial pilot's license and English for transition into jet transport aircraft.

Such English courses aim to transfer the knowledge *how* to something, and are less focused on knowledge *about* the task. They are targeted at specific language outcomes, for specific communications. They are short-term and highly intensive—only 25 hours long. Classes practice with authentic materials in near-authentic activities, simulate the flight performance in-class and learn, practice, and demonstrate their ability to perform successfully in a mock-real setting.

Classes in intensive language training are small. We try to make 15 the maximum, and prefer 12, but have worked with 20 in a class. We work the class for five hours per day. Two hours address diagnosed language issues such as pronunciation and fluency and three hours are spent in specific activities designed to produce the specified training performance. To allow fluency to develop, we provide informal practice opportunities: open use of a language laboratory, paid and volunteer conversation partners, and participation in a rich social/cultural programme.

This type of intensive language training is not the only language preparation that we provide at Embry-Riddle. Some time before their admission into the university programme, our students have acquired the skills necessary for success at university, a capacity to listen to a lecture and take notes, to participate in a discussion, to read and prepare a satisfactory paper, and so on. In our English for Academic Preparation programme, we address the "education" issues such as study skills, practising ways to gather and consider information, seeking the growth of ideas, encouraging maturation.

By using aviation-specific content in texts, on computers and in varied in-class exercises, we pointedly expose our student learners to practice in the language and knowledge they will need for their university degree courses. In our English for Academic Preparation programme over 16-week/400-hour semester, we work in a less-intensive way than in the English for Specific Purpose flight language courses.

These customised contents of the intensive courses have now been adapted for use in other locations where similar training takes place with other pilot populations. The Boeing Company and the Flight Safety Academy are two clients for whom we have adapted and developed these courses. From Embry-Riddle multi-lingual classes of relatively high proficiency students, we have made amendments to accommodate mono-lingual trainee pilots from international airlines. These highly motivated pilot trainees have been selected from a very competitive process. And we have applied the same design-model in English training with Chinese air traffic controllers of the Civil Aviation Authority of China in contracts with Delta Air Lines, United Airlines and Federal Express Corporation.

Testing. We are continuing to establish and refine the testing we do to validate the training and to refine grading of acceptable performance. We do this by scoring each trainee's performance in behaviour as near to the actual task as practical. Our language tests aim to score the trainees' understanding of the *form* of the target language, their understanding of its *meaning* and their *use* of it. The first two receptive language items are scored in a multiple-choice format and for the third we are attempting to use voice recognition software to score productive language in pronunciation, fluency and appropriateness.

To sum up, by identifying and staying close to the specific English language required to perform successfully in a target technical training, we have been able to conduct reliable English preparatory courses that give predictable results.

In doing so we may have invented a new acronym—TREVOR; Teaching Real English for Very Obvious Reasons.

Poster Presentations

The following papers were submitted to TEND 97 by participants who were unable to make formal presentations.

The Norwegian Education System: Higher Technical and Scientific Education In Norway

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Part I: The Norwegian Education System

The population of Norway, 4.2 million people, is scattered over an area of almost 400 square kilometres, which means that we are thirteen to the square kilometre.

Norway is divided into 19 counties and 435 municipalities. The state, the counties and the municipalities have the following responsibilities as regards education.

The municipalities are responsible for running the primary and lower secondary schools (compulsory education). The local authority dealing with education is the municipal council. The municipality is responsible for the building and maintenance of school buildings and for appointing the teachers.

The counties are responsible for upper secondary education. The county is responsible for the running of the schools, the intake of pupils and the appointment of teachers.

The State (The Royal Ministry of Education, Research and Church Affairs) has the overall responsibility for higher education.

Universities and Colleges	Upper Secondary Education	Compulsory Education
	general (3 years)	Primary (7 years) and lower secondary
	vocational (4 years)	(3 years) education
Run by the State	Run by the counties	Run by the Municipalities

The principle of equality in terms of educational provision has long traditions in Norway and the overall aim for the Government is to ensure equal rights to education for all, independent of gender and social, geographical and cultural background.

During the 1990s, education has become a priority area in the political debate. It is generally recognised that education is a key to economic, social and cultural development and is essential for greater cohesion, solidarity and international understanding in a world of religious and political tension.

The impact of increasing technological, economic and social change is felt in Norway as well as in other European countries. With rapid changes in production method, practical skills must be related to general knowledge and be continuously updated. This situation puts new demands on competence and qualifications. It has become necessary to update our knowledge in order to increase the value of the national output, to maintain the level of employment and to create new jobs. Extensive education reforms are therefore being carried out in Norway involving a review of all levels of education:

From 1994: Reform in upper secondary education

From 1994: Reform in higher education

From 1997: Reform in primary and lower secondary education (compulsory education)

From 1998: Life-long learning reform for people in work

The focus of interest in these reforms is twofold:

- Action to strengthen the structure of the education system
- Focus on the content of education and training

This is done because we believe that education will increasingly have to be considered in a life-long perspective and that systems of continued education and training and life-long learning must be developed.

Compulsory Education

Norway has about 500,000 pupils in compulsory education and this education is run by the municipalities. However, the Government has the final responsibility and 18 National Education offices throughout the country, representing the state, ensure that government decisions are carried out.

The aim of the compulsory education is to give all children an education adapted to their individual abilities. The national assembly, the Storting, has decided that compulsory education shall be expanded from nine to ten years from 1997, i.e. starting with the six-year olds, beginning school in 1997. But the Government's White Paper on compulsory education states that this is more than just adding one extra year to the existing school system. This reform is:

- a family reform which, by expanding the scope of school activities, provides a secure environment for children while their parents are at work.
- a children's reform, which gives schools greater responsibilities for the growth environment of children, richer impulses and wider scope for learning, based on organised activities together with adults and on children's own independent activities.
- a school reform, introducing ten years of compulsory education from the age of six, and including a reform of content, teaching and learning methods throughout the entire ten-year period.
- a cultural reform, whereby more activities in the local community, including crafts, sports and artistic endeavour, become part of the day-to-day life of schools.

As part of the reform a new curriculum for primary and lower secondary schools has been developed, defining the principles, guidelines and subject syllabuses for the ten-year compulsory education. Many of the over-riding principles defined in the earlier curriculum guidelines still apply, such as:

- teaching based on fundamental Christian and humanistic values
- good co-operation between home and school, based on equality and mutual respect
- suitably adapted education for all pupils
- local work, e.g. adaptation of subject matter to local conditions at municipal, school or class level

- a diversity of teaching methods, as an integrated part of the different subjects

The classes are organised according to age, starting in first grade at the age of six, finishing with the tenth grade at the age of 16. Each class is kept together as one unit from first to seventh grade, and in many cases even to tenth grade. However, in small places, with a low density of people, schools do not have separate classes for all age groups.

The school year for primary and lower secondary school consists of 38 weeks, with five days of teaching every week. The number of lessons is about 20 per week in first grade, increasing to about 30 lessons in tenth grade. The following subjects are included in more or less all grades:

- Norwegian
- Mathematics
- Religious instruction
- English
- Two foreign languages: often German or French (from eighth grade)
- Natural sciences
- Social studies
- Music, arts and crafts, home economics
- Physical education

Upper Secondary Education

According to legislation, it is the 19 counties that have the administrative responsibility for the planning and operation of upper secondary education. However, based on decisions made by the Storting, the Ministry of Education, Research and Church Affairs gives the overall guidelines, e.g. determines the system of education, national subject curricula, the length of school year, and the maximum size of classes.

As mentioned above, Norwegian upper secondary education has been through a large scale reform. The reform was initiated when the Storting approved the Government's White Paper on Upper Secondary Education and it was decided that the reform (Reform 94) should be carried into effect in the autumn of 1994.

The Government's White Paper on Upper Secondary Education gives the following general principles:

- Equal right to education
- The provision of a general, solid and relevant body of knowledge
- Scope for local adaptation
- A satisfactory balance between general knowledge and specialization
- A clear definition of the basic knowledge and skills needed as a basis for specialization and future learning
- The creation of closer links between upper secondary education and community life
- The development of international co-responsibility and ecological understanding

The adoption of these principles has wide reaching practical consequences:

- the introduction of a statutory right (but not an obligation) to three years of upper secondary education for all between 16 and 19 years of age, with a corresponding obligation for the counties to provide the adequate number of school places.

- The counties are charged with the duty of providing additional school places for pupils with special needs and adults.
- The counties are responsible for following up pupils who do not use their statutory right of upper secondary education and are not in employment. The aim of this service is to ensure that all young people, as far as possible, get the opportunity of an education that leads to a recognised qualification.
- For pupils that choose vocational education, the model combines two years in school followed by two years of subsequent training in industry. The time spent on the development of the trainee's skills (one year) and the time spent on work from which the company benefits (one year) are clearly distinguished. If there are insufficient apprenticeship places in the industry, the counties are obliged to establish training courses in schools.
- Before the reform, the number of foundation courses was 109, and currently, after the reform, it is 13. These now provide a broad knowledge base for specialization and life-long learning.
- A greater degree of vocational specialization takes place in Advanced Course I and especially in Advanced Course II (which should be carried out in industry).
- A general matriculation standard has been introduced, satisfying formal entry requirements to higher education. The minimum requirements include:
  - Successful completion of three years of upper secondary education including:
  - Foundation course, advanced course I and advanced course II (regardless of area of study), or recognised vocational qualification/trade certificate
- Included in, or in addition to the above criteria, it is necessary to have successfully completed upper secondary studies corresponding to a specific level of attainment within the following general subject areas: Norwegian, English, history and social studies, mathematics, natural science.

Applicants can be admitted to higher education without having passed the normal upper secondary final examinations. Such students must, however, fulfil the specific minimum subject requirements mentioned above, be 23 years old or more, and have at least five years of work experience, or a combination of work experience, education and training.

Pupils who have chosen general secondary education, fulfil these requirements. Those who have chosen vocational education need to take some extra education to reach the specific level of attainment within the above mentioned general subjects.

General Vocational

Almost all the lessons of the foundation courses are filled with compulsory subjects, while approximately half the lessons in Advanced Course I and II consist of options, among which the pupils can choose according to certain rules. The pupils can choose from science (mathematics, physics, chemistry, biology or computer science), business administration and economics, languages and social studies.

There are two other types of upper secondary education which also satisfy the minimum matriculation standards for higher education, but are somewhat different than described above. These are options with specialization in sports and in music/dance/drama, in which optional subjects in Advanced Course I and II are limited and substituted with sports and music/dance/drama, respectively.

Vocational Upper Secondary School

It is possible to choose between ten different study areas of vocational upper secondary education. These areas correspond to the ten different foundation courses:

- building and construction training
- agriculture, fishing and forestry training
- technical building training
- electrical training
- health and social training
- hotel and food-processing training
- chemistry and processing training
- arts, crafts and design training
- mechanical training
- woodworking training

In all the ten different foundation courses, some general subjects are included: Norwegian, English, mathematics, science and social studies. However, the level of attainment in these subjects does not satisfy the general matriculation standards required to enter higher education.

As mentioned above, the pupils choose different kinds of specialization in Advanced Courses I and II. After successful completion of vocational upper secondary education, they become skilled workmen.

Those who have completed vocational upper secondary education can continue to higher education after a one year qualification course. Another alternative is to continue into a two-year technical school which will qualify for higher education and give further technical training. Education at these technical schools is not considered as higher education. These schools are originally meant for those who want to become technicians, who in Norwegian industry are considered as middle-men between the skilled workmen and the engineers.

Higher Education

Higher education in Norway is divided into two sectors; the university sector and the non-university sector. Most higher education institutions are state-owned and tuition at these institutions is free. In addition, some private institutions are certified to offer higher education. Finally, it is becoming more and more popular for students to study abroad. This is considered an important element of the Norwegian education policy.

Today, there is an estimated total of 173,000 students in higher education:

- 81,600 in the university sector (74,400 at the university and 7,200 at the university colleges)
- 68,800 in the non-university sector
- 13,600 in private institutions
- 9,000 abroad

This is an increase of 7% over the last seven years and now almost every other graduate opts for higher education.

A major priority during the 1990s has been to link all Norwegian universities and colleges in Network Norway in order to create a structural framework for increased co-operation and communication between institutions. The present policy in higher education may be referred back to the 1988 Royal Commission report on higher education and the 1991 White Paper, in which the term "Network Norway" was coined to denote a national higher education and research network based on the principles of specialization, co-operation and communication. A governing principle of the network is that new study programmes should be planned and viewed in relation to an overall national plan.

As a follow-up to the White Paper and as preparation of a new law on higher education and the development of "Network Norway," the non-university sector was reorganised as of August, 1994, a process through which 98 regional and vocational colleges were merged into 26 'state colleges'. It is worth noting that most of the increase in student numbers over the past decades has taken place with this system of colleges.

In January, 1996, the new law on all higher education was introduced. This law gives the institutions of higher education a considerable degree of academic and administrative autonomy, while leaving decisions on overall organisation to the Ministry. The institutions can not be instructed as to the content of their teaching, research or artistic work.

The University Sector

The university sector consists of the four universities:

- The University of Oslo
- The University of Bergen
- The University of Tromso
- The Norwegian University of Science and Technology

And the 6 specialised university colleges:

- The Norwegian College of Agriculture
- The Norwegian College of Veterinary Medicine
- The Norwegian School of Economics and Business Administration
- The Norwegian College of Physical Education and Sports
- The Norwegian State Academy of Music
- Oslo School of Agriculture

The universities offer degree programmes at three levels in the humanities, social and natural sciences:

- The lower university degree "cand.mag.", normally obtained after 3 years
- The higher university degrees "cand. philo." (humanities), "cand. scient." (natural sciences), and "cand. polit." (social sciences), obtained after 5 years of study.
- The doctoral programmes of three years duration after completion of the higher degree, leads to the degrees "dr. artium" (humanities), "dr. scient." (natural sciences) and "dr. polit." (social sciences).

In addition, some university faculties and the university colleges offer professional programmes requiring four to six years of study, e.g., in agriculture sciences, business administration, economics, psychology, medicine, dentistry, law, engineering, theology, and architecture, as well as three-year doctoral degree programmes in these subjects.

It should be mentioned that it is only the institutions in the university sector that can award the doctor's degrees.

The Non-University Sector

The growth and development of the non-university sector is closely related to a Government policy in which higher education is regarded as an important contributor to the economic, social and political life of local communities. As mentioned above, a major reorganisation of the non-university sector, including the merging of colleges, reduced the number of institutions from 98 to 26.

The 26 'state colleges' (former regional and/or vocational colleges) offer:

- Traditional vocational studies (e.g. engineering, social and health education, teacher education)
- Other vocational-oriented study programmes of shorter duration (e.g. economic administrative education, translation, journalism, fisheries, aquaculture, environmental studies)
- Traditional university studies for the lower degree "cand. mag."

All the colleges may confer the "cand. mag." if two or more of the different study programmes are combined. Some state colleges also offer higher degree programmes.

As a means of facilitating and encouraging student mobility between higher education institutions in the country, degrees (most often "cand. mag.") can be conferred on the basis of studies from a combination of higher education institutions. This system generally implies reciprocal recognition of study programmes between higher education institutions on a time for time basis. (Exception may be made in cases of overlap, or in specific programmes which have been given reduction in "transfer time" by the Ministry.)

The two arts and crafts colleges, which offer programmes in ballet, drama, opera, visual arts, crafts and design, are also included in the non-university sector.

Life-long Learning

The Norwegian education system is undergoing demanding reforms. Development and adjustment for continuing learning for adults will be the next building brick in a complete system of life-long learning.

Today, the changes in work take place frequently. A lot of workers find that the content of their work changes faster and faster. More often than before, the workers and professionals must change their place of work and even change professions. Because of this, continuing education and training becomes more and more important. The authorities must therefore, together with the federations for workers and employers, improve the workers' possibilities for continuing education and training.

The future policy for continuing education must build on an analysis of what the Norwegian society needs. Currently, there is an ongoing discussion related to the modalities concerning the financing and organisation of continuing education and training in a life-long perspective. However, the extent of the new reform will depend on the willingness of workers' and employers' federations to prioritise continuing education and training.

The Government has appointed a Royal Commission, which will consider the basis for a national action plan for continuing education. The main points in the commission's terms of reference are to:

- Describe and analyse the ongoing continuing education for adults
- Consider the need for a life-long learning reform
- Consider a statutory right for continuing education and training for all workers
- Consider organisational and financial aspects of the reform
- Consider methods of assessing practical skills and competencies

The commission shall submit their report on October 1, this year. Based on this report, the Government will present a White Paper on continuing education to the Storting (according to a plan in Spring 1998).

Part II – Higher Technical and Scientific Education in Norway

Structure of the Higher Technical and Scientific Education in Norway

Higher education in technical and scientific subjects is given by universities and colleges. It is possible to obtain different types of degrees, following different programmes.

There are three important degrees in technical and scientific subjects:

- Hegskoleingenior (Engineer)—a three year professional education
- Sivilingenior—a five year professional education
- Candscient—a five year scientific education

These will be further described below:

Hegskoleingenior

Norwegian engineering education is a three-year professional programme leading to the degree *hegskoleingenior.*The teaching is at a technical theoretical level and is anchored in practical engineering. The aims, the structure and the content of the programme are stipulated in a framework plan which is approved by the Royal Ministry of Education, Research and Church Affairs.

The framework plan will ensure the development and quality of the engineering education and the authenticity of the degree *hegskoleingenior*. Engineering education should provide engineers who combine technical and theoretical knowledge with practical skills and who take responsibility for the interaction between technology, environment and society. The education should be based on research with emphasis on applied research and development. The education will maintain a high technical and scientific level in an international context and will lay the foundation for life-long learning.

The degree *hegskoleingenior*meets the academic requirements for the title of European Engineer (Eur. Ing.), awarded by the European union of engineers. The Eur. Ing. degree, in addition, has specific requirements for work experience. The Norwegian three-year programme in engineering can also constitute the basis for further (graduate) studies at a university.

16 state colleges, one private college and one army college offer engineering education. The colleges are situated all around Norway.

The three-year engineering education in Norway is grouped in five main fields of study. They are:

- Civilengineering
- Computerengineering
- Electrical and electronic engineering
- Chemicalengineering
- Mechanicalengineering

Within each of the five main fields of study, it is possible to specialize in several disciplines. Each field of study normally includes a set of 'ordinary' disciplines, as follows:

Civil Engineering: Building
ConstructionTechnology
Technical Planning
SiteEngineering
Computer Engineering Computer Science
Management of Data Systems
Electrical and Electronic Power Engineering
Engineering
Electronics
Telecommunications
Automation Technology
ChemicalEngineering
Analytical Chemistry
Biotechnology
Chemical Technology
MechanicalEngineering
General Mechanical Engineering
ConstructionTechnology
Manufacturing
Control and Energy Engineering

In addition, there are more specialized fields of study and disciplines at some of the colleges which are suited to business and industry in the region where the college is situated. For example, petroleum technology at the college in Stavanger—Norway's oil capital.

A completed engineering degree gives 60 credits which in the Norwegian system equals three years' full-time study. (In other words, students should obtain 20 credits per year.)

A sound mathematical and scientific understanding is the foundation of all engineering education. This foundation is provided by compulsory general subjects. In addition to technical subjects which are specific for each field of study and discipline, the engineering education includes courses in social and economic subjects. At the end of the studies, students must do an independent research project.

Thus, the study programme consists of six main elements: general subjects, social and economic subjects, technical field subjects, technical discipline subjects, optional subjects, and a research project:

General subjects	15 credits
Mathematics and statistics	8 credits

Science	5 credits
Computer science	2 credits
Social and economic studies	5 credits
Technical subjects	30 credits
Field subjects	10 credits
Discipline subjects	20 credits
Optional subjects	5 credits
Research projects	5 credits

The final research project provides an opportunity for students to obtain some practical work experience. The research project should, if possible, be carried out in co-operation with industry, business or public service, and it should have a realistic engineering problem as a starting point and be organised in such a way that the students can use skills and knowledge from several areas of their training.

In 1996, approximately 3,000 students enrolled in engineering education, although the capacity provided is for almost 3,700. In Norway today there is a problem recruiting enough students for higher technological and scientific education, despite the fact that the job market for people with this kind of education is very good. There may be several reasons for this. Only four or five years ago, the job market for engineers was totally different than what is it today, with massive unemployment for people with a technological background. However, over the last one to two years this has changed dramatically.

Another problem is that fewer and fewer pupils in general upper secondary education choose mathematics and physics in Advanced Course I and II. The subjects are, however, required for admission to engineering education.

In the 70s and 80s women started choosing programmes in higher education that were typically dominated by men. Now, we see that this is no longer the case and both men and women have fallen back to more conservative choices.

This situation, which is the same in most West-European countries, is considered very serious for Norwegian industry and the Ministry of Education has proposed initiatives to counteract this development.

Sivilingenior

The *sivilingenior* degree is awarded after completion of a five year study programme. It is a technical and theoretical education and at the same time geared towards practical problem solving. This programme is, however, not regulated by a national framework plan.

There is one leading institution for sivilingenior education: the Norwegian University for Science and Technology (NTNU), situated in Trondheim, but the degree can also be obtained at the other three universities, in Oslo, Bergen and Tromso, at the Norwegian College of Agriculture and at three of the state colleges.

The first two years of a sivilingenior programme provide a solid foundation in basic subjects such as mathematics, physics, chemistry, mechanics, computer science and social and economic subjects. In the third and fourth years, greater emphasis is laid on technical subjects specific to each course of study and at the end of the studies, students carry out a project, often in co-operation with industry, business or a research institution.

At NTNU, eight faculties offer engineering education. These are the faculties of:

- Civil and Environmental Engineering
- Electrical Engineering and Telecommunications
- Applied Earth Sciences and Petroleum Engineering
- Physics, Informatics and Mathematics
- Chemistry and Biology
- Marine Technology
- MechanicalEngineering
- Social Sciences and Technology Management

The sivilingenior programme at the Norwegian College of Agriculture offers courses in Civil Engineering, Environmental Technology, Biological Production and Forestry.

The three state colleges offer two-year sivilingenior programmes for students holding a hegskoleingenior degree.

In 1996, approximately 1,500 students were enrolled at NTNU in a sivilingenior programme and almost 500 students were enrolled in corresponding programmes at other institutions.

Other science programmes at the universities

The four universities in Norway: the University of Oslo, the University of Bergen, the University of Tromso (the world's northernmost university), and NTNU, all have faculties of mathematics and natural sciences which offer undergraduate and graduate programmes in scientific and technological subjects. Compared to the engineering programme, traditional university studies are more theoretical and research oriented. The higher degree, cand. scient. (candidatus/candidata scientarum), aims at providing training for independent research and at strengthening a student's academic foundation for teaching and for practical application of a chosen main subject.

In principle, the graduate programme is open to all students having obtained the cand. mag. degree or having equivalent academic qualifications. This programme requires one year of study and leads to the cand. scient. degree. For a definitive admission the student must work out a plan for a research project with one of the lecturers at the faculty and this plan must be approved. The research project gives an opportunity for in-depth study and methodical learning in a subject. In addition to the research project, a theoretical curriculum of ten credits (one-year work load) must be completed.

Structure of the cand. mag. and cand. scient. degrees:

In 1995, 787 students graduated with Cand. Scient. degrees from the four universities in Norway.

Dr. Ing. / Dr. Scient

Dr. ing. and Dr. scient. are the highest academic degrees in technical/scientific subjects in Norway. Programmes leading to doctorates have a duration of three years and build on the sivilingenior Cand. Scient. degrees. Dr. ing./Dr. scient. give training in scientific research. There is also a traditional general doctor's degree: Dr. philos.

In 1995 (most recent statistics), 155 Dr. scient. and 133 Dr. ing. degrees were awarded.

Technological Education in Malaysia

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1.0 Introduction

Malaysia was fortunate to inherit stable public administrative and educational systems at the time of its independence in 1957. However, it faced real socio-economic constraints due to the multi-racial, multi-cultural and multi-religious composition of its population. All development plans formulated, addressed the issue of communalism while pushing for economic growth. In addition, emphasis is now shifted from the production and export of primary commodities to a more industrial economy.

During the period, 1971–1990, when the New Economic Policy took effect, the GDP was growing at an average rate of 6.7%. During the Sixth Malaysia Plan, 1991–1995, the GDP grew at the rate of 8.7%. Per capita income increased from RM 1106 in 1970 to RM 9786 in 1995. The Industrial Master Plan, launched in 1985, further provided a blueprint for an accelerated industrial development.

The objectives of the Seventh Malaysia Plan, 1996–2000, are formulated based on the strategies developed in the National Development Policy and those from the Outline Perspective Plan II, 1991–2000. Here is again another planned shift in economic growth from an input or investment-driven to productivity-driven economy. Hence, the development of human resources plays the pivotal role in the push for productivity-led growth, thereby creating the need for an increase in investment in education and training. On the same plane, there is a need to enlarge and enrich the science and technology base. The plan also incorporates proposals for achieving qualitative improvements like promoting private sector participation in science and technology development, nuturing domestic innovations and inventions and fostering better collaboration among research agencies, industries and universities.

2.0 Policy Development

The development of education, especially that of technology, is closely related to that of the country. The most striking feature in the modest success of Malaysia is the policy development. (Fig. 1) This paper attempts to highlight relevant policies developed from 1970 through 2000.

The New Economic Policy (NEP), covered the period 1971 to 1990, addressing key issues like racial imbalance and the eradication of poverty. Rukun Negara, National Ideology, was introduced in 1970 in order to provide the basic framework for the building up of a nation state. The Outline Perspective Plan 1 was a 20 year development plan, closely associated with the New Economic Policy, covering four five-year Malaysia Plans. The five-year Malaysia Plan is a comprehensive document, passed by the Parliament, comprising the whole range of policies, strategies and plans, including budget allocation. The Malaysia

Incorporated, introduced in 1983, was aimed at setting an effective partnership between both the private and public sectors.

The Industrial Master Plan 1985 was aimed at building up an industrial infrastructure in the push towards globalisation. The Outline Perspective Plan II (1991–2000) is a 10-year plan covering both the Sixth Malaysia Plan (1991–1995) and the Seventh Malaysia Plan (1996–2000). The VISION 2020, espoused by the Prime Minister in 1991, provides an aspiration for Malaysia to be an industrialised country.

Malaysia—Policy Development

Year	Programme / Plan / Policy
1970	Ruken Negara
1971	New Economic Policy 1971–1990
1972	Outline Perspective Plan 1 (1970–1990)
1973	
1974	
1975	3rd Malaysia Plan (1976–1980)
1976	
1977	
1978	
1979	
1980	
1981	4th Malaysia Plan (1981–1985)
1982	
1983	
1984	Malaysia Incorporated
1985	
1986	
1987	5th Malaysia Plan (1986–1990)
1988	
1989	
1990	
1991	Outline Perspective Plan II (1991–2000)
1992	6th Malaysia Plan (1991–1995)
1993	National Development Plan
1994	Vision 2000
1995	
1996	
1997	7th Malaysia Plan (1996–2000)
1998	
1999	
2000	

Figure 1

3.0 Policy Support

In the development of technological education, it is interesting to note the case of the National Development Policy where the main objective is to attain a balanced development in order to create a more united and just society.

Essentially this is built upon the New Economic Policy where the twin objectives are the restructuring of society and the eradication of poverty. Two of the critical aspects of the policy are:

a) promoting human resource development including creating a productive and disciplined labour force and developing the necessary skills to meet the challenges in industrial development through a culture of merit and excellence without jeopardising the restructuring objectives.

b) making science and technology an integral component of socio-economic planning and development, which entails building competence in strategic and knowledge-based technologies, and promoting a science and technology culture in the process of building a modern industrial economy.

In order to support the implementation of technology-based industrial strategies, according to the Seventh Malaysia Plan, several advanced technologies are being promoted, including

a. IT and Communications
- high performance computing
- networking
- communications
- digital imaging
- multi-media
- high definition display
- high density storage
- software
- simulation and modelling

b. Microelectronics
- sensor technology
- semiconductor materials and microelectronic ciruits
- opto-electronics
- avionics
- advanced semiconductor devices

c. Biotechnology and Life Sciences
- biotechnology materials and processes
- medical devices and diagnostics
- medical technology

d. Advanced Manufacturing Technology
- flexible computer integrated manufacturing
- machine intelligence and robotics
- micro and nano-fabrication
- systems management technology
- composites
- ceramics
- semiconductor materials, microelectronic circuits and photonic materials
- materials synthesis fabrication
- superconductors
- high performance metals and alloys

e. Environment And Energy Related
- green materials
- agro-based waste

- renewable energy
- portable energy
- pollution minimisation, remediations and water management

In view of the need for an increasing number of skilled and semi-skilled labour, the Integrated Action Plan for Human Resource Development proposes:

- that all training performed under the supervision of departments and agencies is required to utilize full capacity and a new emphasis;
- that the capacity of industrial training institutes will be expanded and upgraded, including the construction of additional hostels;
- to develop a polytechnic in Sabah and five new industrial training institutions;
- to expediate the upgrading of existing vocational schools into technical schools to ensure that training is skill oriented
- that training will combine theory and practice in the fields of manufacturing and usage of the latest technology of the Malaysia German Institute and French Malaysia Institute;
- companies like Telekom, PETRONAS and Tenaga Nasional will expand their training and educational programmes on a large scale;
- to provide exposure for trainees in the private sector and continue the programme for skilled training in industries overseas, including Japan;
- In addition, to step up private sector involvement in technical and vocational training programmes and to introduce automation to alleviate the acute labour shortage, the following tax incentives are provided: contributions in cash or in kind to government and quasi-government training institutes and vocational and technical training institutions will be allowed income tax deductions;
- companies which establish technical or vocational training institutes will be eligible for Investment Tax Allowance of 100% for 10 years;
- existing technical or vocational training institutions undertaking additional investments to upgrade equipment or expand their capacity are also eligible for the same incentives. Technical or vocational training institutions are also eligible for exemption from import duties, sales tax and excise duties on materials, machinery and equipment used for training; and
- employees who further their education on a part-time basic in science, technology and vocational fields will be given tax exemption on their education fees up to RM 2000.

4 Technological Education

4.1 Educational System

The basic educational system of Malaysia is as shown in Fig. 1. The system begins with the pre-school, age group of 5 to 6, followed by the primary (age group of 6 to 11), secondary (age group of 12 to 16) and post secondary.

In 1990, 328,800 pupils were enrolled with pre-schools followed by 3.4 million at primary schools, as shown in Fig.2. 83% of these eligible proceeded to the lower secondary schools and a further 68% went on to the upper secondary level. At the upper secondary schools, 22.8% were enrolled in the science and technical streams. There are three main streams at this level comprising:

a) Secondary Technical School (STS)
b) Secondary Vocational School (SVS)
c) Normal Secondary School

The student ratio of the Secondary Technical School and Secondary Vocational School to the normal school is 9%. The important outlets for the students of the STS and the normal schools are the institutions of higher learning. However, the outlet for the students of the SVS is generally the job market especially in the semi-skilled sector.

In 1995 the pattern was the same as that for 1990 except for some improvement in terms of percentages. The significant changes were that:

a) There was an improvement of 15% for the students moving from the lower secondary level to that of the upper secondary.
b) There was a 13.3% improvement of the student participation at the upper secondary school levels.
c) There was a drop of 1.5% in the number of science and technical stream students. This is mainly due to the fact that more parents motivate their children to go into the commercial stream.
d) The student ratio of the STS to that of other streams increases from 10% in 1995 to 15% in 2000.

Degree Certificate Teacher Training Pre diploma/University 6th Form
Upper Secondary School
Secondary School
Lower Secondary School
Pre-School

Figure 2: Malaysian Educational System

4.2 Primary Schools.

A significant development in relation to technological education is to instil interest in science from an early age with the introduction of elements of science at primary school level I itself. Science as a discipline is also taught at levels IV through to VI. New mathematics syllabi were introduced to levels I through to VI at the beginning of 1997.

4.3 Secondary Technical Education.

Secondary technical education is aimed at producing an adequate pool of qualified students who excel in mathematics and science as well as in basic engineering subjects. These students are expected to continue their studies in the science and technology-related courses at the diploma and degree levels as well as in advanced skills.

To address the critical shortage of engineers and skilled workers, the Government will launch a massive effort to convert all the 69 SVS to STS. By the year 2000, all STS, are expected to have a total enrolment of 89,440 students. In addition to STS, engineering subjects will also be introduced in 15 fully residential schools in selected secondary schools, benefitting a total of 7000 students by the year 2000.

4.4 Tertiary Education.

The demand for an educated and skilled workforce will increase in tandem with the country's rapid industrialisation. Hence, the aims in the 7MP include,

1. improving quality and relevance of courses offered so as to match national manpower requirements;
2. increasing the enrolment at the first degree level in local public institutions for those in the 19-24 age-group from 3.5 in 1995 to 5.6% in the year 2000;
3. increasing the capacity of enrolment in the science, engineering and technical-related courses so as to intensify the production of manpower with science and technical knowledge;
4. increasing the capacity for post-graduate courses from 11.5% of total enrolment at the degree level in 1995 to at least 14% in the year 2000 increasing the capacity and capability to undertake research and development, particularly those which are relevant to industrial and services sectors requirements;
5. increasing private sector participation to supplement Government effort in expanding tertiary education opportunities, while at the same time helping to reduce the growing public expaditure on education. (TNB, TMB, PETRONAS)

The following tables reflect the status of the technological education

Table 1

Programme	*Enrolment 1995*	*Enrolment 2000*
1st degree enrolment	153,600	257,100
Science and Technical Courses	76,300 (50%)	132,050 (53%)

Table 2

Courses	*1990*	*%*	*1995*	*%*	*2000*	*%*
Science	14460	27%	22290	28%	42280	29%
Medicine and Dentistry	2380		2580		5230	
Agriculture and Related Science	1610		3260		4330	
Pure Science	4610		5580		8150	
Others	5860		10870		24580	
Technical	7130	14%	13430	17%	31450	22%
Engineering	5520		10430		24750	
Architecture and Town Planning	640		1750		3670	
Survey	300		460		1160	
Others	670		790		1900	

1995 estimated

506000 enrolled for degree courses abroad

18,300 government-sponsored (59.8% + technical courses)

Pure science: physics, biochemistry, mathematics

Others: applied sciences, environment studies, food, tech, pharmacy and science with education

Table 3

	UM	*UKM*	*USM*	*UPM*	*UTM*	*UIA*	*UUM*	*UNIMAS*	*UMS*	*ITM*	*KTAR*
Arts	8,960	9,370	9,560	3,660	210	4,050	10,060	480	310	4,540	2,890
Science	4,490	3,890	6,170	9,130	3,640	12,120	1,410	810	230	800	2,200
Technical	1,190	720	2,840	2,180	6,480	1,000	0	140	0	3,320	2,140
Total	14,640	13,980	18,570	17,970	10,330	6,260	11,470	1,430	540	8,660	7,230
% Science & Technical	39%	33%	49%	76%	98%	35%	12%	66%	76%	48%	60%

Table 4

Category	*1990*	*1995*	*Share %*
Managerial and Professional	50,281	88,219	4.3
Technical and Supervisory	114,592	184,644	9
Clerical	88,840	129,250	6.3
General Worker	53,620	63,600	3.1
Skilled	351,765	533,416	26
Semi-skilled	209,698	359,030	17.5
Unskilled	464,134	693,441	33.8
Total	1,331,829	2,051,600	100

Table 5

	1990	%	1995§	%	2000	%
Profession, Technical & Related Works	586.4	8.8	815.3	10.3	10,970.0	12.1
Administrative & Managerial Workers	163.8	2.4	213.7	2.7	290.1	3.2
Clerical and Related Workers	652.6	9.8	799.3	10.1	933.8	10.3
Sales Workers	768.9	11.5	894.4	11.3	1,042.6	11.5
Service Workers	77.6	1.6	981.5	12.4	1,169.5	12.9
Production & Related Workers, Transport, Equipment Operators and Labourers	1,846.0	27.6	2,548.8	32.2	3,046.2	33.6
Agricultural, Animal Husbandry & Forestry Workers, Fishermen and Hunters	1,890.7	28.3	1,662.2	21.0	1,486.9	36.4

Table 6

Programme	6MP	%	7MP	%
Education	7,409.8	92	8,437.2	83.5
Pre-School	61.8	0.8	107.4	1.1
Primary Education	1,184.7	14.7	1,396.0	13.8
Secondary Education	2,050.7	25.5	2,447.9	24.2
Government & government-aided school	1,603.0	20.0	1,781.9	17.6
MARA Junior Science College	28.7	0.3	367.0	36.3
Technical and Vocational schools	419.0	5.2	299.0	3.0
Tertiary Education	3,139.3	37.8	2,961.8	29.3

Teacher Education	180.1	2.2	458.8	4.5
Other Education Support Programme	793.2	9.9	1,065.3	10.5
Training	615.4	7.6	1,661.6	16.5
Industrial Training	387.4	4.8	1,303.3	12.9
Commerical Training	14.0	0.2	66.3	0.7
Management	214.0	2.7	292.0	2.9
Total	8,025.2	100.0	10,098.8	100.0

5 Technological Education–Performance.

5.1 Enrolment and Output

Table 2 refers to the enrolment for the first degree courses from local public educational institutions from 1990 to 2000.

In 1990, 41% of the places available at public educational institutions were in science and technology. The percentage increased to 45 in 1995 and 51 in 2000. However such percentages are still low compared to the developed and industrialised countries.

Table 3 illustrated the expected output of graduates from the eleven universities and institutions of higher learning in Malaysia between 1996 and 2000. It can by seen that 18% of the universities/IHL produce more than 75% of science and technical graduates from their enrolment. So does 45% of the universities/IHL produce more than 50% of science and technical graduates. Hence 5.5% of the universities/IHL produce less than 50% of the science and technical graduates.

5.2 Employment

The pattern of employment in the manufacturing sector is as given in Table 4. In order for the productivity-driven strategy to succeed, greater emphasis must be given to the increase in the number of the professional, technical and supervisory and skilled groups of personel.

Table 5 shows a very slow increase in the participation of the professional and technical personnel from the year 1990 through 2000. Again this should be the focus of policymakers when working in the development planning.

5.3 Development Allocation

Table 6 provides the information on the development allocation for education and training. The allocation of RM 10.1 billion for education and training constitutes 15.4% of the total public development budget for the 7th Malaysia Plan. Whereas, RM 8.1 billion allocated in the 6th Malaysia Plan counstituted just 13% of the total budget. Thus the allocation for the 7th Malaysia represents an increase of 25% over the 6th Malaysia Plan. While there was an increase of 46% for the 6th Malaysia Plan over that of the 5th Malaysia Plan. While the allocation for education and training for the 7th Malaysia Plan appears to be fair it is still not enough to cope with the increasing demand of the manpower in the technological field.

On the total allocation in the education sector, 45.6% was for the construction of the new schools and additional classrooms for the primary and secondary levels and another 35.1 to expand the capacity of tertiary education. Under the allocation for training sector, 78% was provided for the establishment of new skill training institutes. Such allocation doubled that provided for under the 6th Malaysia Plan.

6 Further Development

The programme of distance learning initiated in the 6th Malaysia Plan is to be enhanced in the 7th Malaysia Plan.

Corporatisation of universities represents a reformation in tertiary education following the market driven scenario. This would enable the universities to have greater autonomy to manage and operate in a more dynamic and proactive manner as well as to be more responsive to changing needs and requirements with greater flexibility in seeking their own revenue sources, increased capacity for consultancy services and commercialisation of research findings as well as recruitment and remuneration of teaching staff.

The recent establishment of the Higher Education Council with membership from both the public and private sectors would ensure greater co-ordination in the planning and development of tertiary education.

The challenges faced by Malaysia relevant to the development technological education include,

a) to transform the economy from an investment-driven output growth towards that which is productivity and quality driven where skill upgrading is crucial;

b) to accelerate the shift towards higher value-added activities that are labour saving and possess greater capital and technology-intensive processes requires greater coherence in the human resource and technology development policies;

c) to encourage a global approach to industrialisation to enable firms to venture into large scale operations so that the benefits of economies of scale can be enjoyed through increased productivity for export to the world market;

d) to promote a more integrated process of production through strengthening inter-industry linkages in particular, increasing production of selected intermediate and capital goods to reduce dependence on imports as well as expand into export markets;

e) to augment competitiveness in the face of greater globalisation advances in technology are essential and needed for reinforcing the nation's competitivness;

f) to strengthen the science and technology and enhance the R and D in order to harness the nation's technological capabilities as well as advancing IT for purposes of switching from being users of multimedia products to suppliers and developers of IT.

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Korea's Human Resource Development Policy

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1. Introduction

The Korean economy has recorded remarkable growth and its development for the past 30 years has been astonishing, which earned its place among the four dragons in Asia. Korea's economic success serves as a model for some countries in their economic planning.

Last year, Korea emerged as the tenth largest trading nation with its stable economy growing by a solid 7.1%. Last year's export stood at 129.7 billion dollars, imports at 150.3 billion dollars and the per capita income rose to the 10,000 dollars level. Also, Korea became the second Asian country to become an OECD member in December, 1996.

- GDP: 4,864 dollars
- Unemployment rate: 2%

The Korean economy's steady growth, despite its lack of resources, including natural resources, is attributable to the good use of human resources.

1. Basic Vocational Training Act

The foundation for the Korean vocational training system was established in 1967 when the Vocational Training Act was made effective. Previously, there were two acts related to training: the Labour Standards Act and the Employment Security Act.

In those days, the first Five-year Economic Development Plan had been accomplished successfully. It led to an increase in demand for skilled manpower and for retraining of those workers, who had worked previously in the primary sector. In this context, the Vocational Training Act was passed, its contents were similar to the vocational systems of the advanced countries, but adapted to the Korean situation.

Hence, the public vocational training projects of the Government were started in full-scale when the legal basis for vocational training was founded and the Central Vocational Training Institute was established in June, 1968, in collaboration with UNDP and ILO for the development of instructors.

In 1976, important changes concerning the vocational training legislation took place. The Vocational Training Act and the Special Measure Act for Vocational Training were integrated into the Basic Vocational Training Act. The payment of a vocational training levy became compulsory for the enterprises not carrying out in-plant training.

2. Public Vocational Training Institutes

Several training institutes were established to harmonise supply and demand according to the rapid progress of the economy. 14 public VTIs such as Korean-Germany Pusan VTI and Chung-soo VTI (Chung-soo Polytechnic College at present) were established with technical support and loans from overseas between 1970 and 1977. In 1977, Chang-won Industrial Masters' College (at present: Chang-won Polytechnic College), was established by the Industrial Masters' College Act and 15 VTIs including Cheong-ju VTI, were established by a loan from the IBRD between 1977 and 1980.

Due to new, edge-cutting technology and the changing structure of the industry, the Korean Government recognised and promoted several VTIs under the KOMA to Polytechnic Colleges in order to provide various training programmes such as master craftsman and technicians in 1994.

3. Korean Manpower Agency (KOMA)

The concept and programme of vocational training were expended in accordance with the rapid change of industrial structure and increasing demand for highly qualified manpower. Hence, the Basic Vocational Training Act was revived and the Korean Vocational Training and Management Agency Act was passed in 1981.

It was the legal basis for the integration of 24 public Training Institutes, and Chang-won Industrial Masters' College, the Korean Technical Qualification Agency and the Vocational Training Research Institute into the Korean Training and Management Agency (at present: KOMA), which also absorbed training functions of the Central Vocational Training Institute and eight rural training institutes. Thus, extended vocational system was set up.

The Korean Training and Management Agency was renamed the Korean Manpower Agency in April, 1991, and reformed its organisation to execute not only vocational training and qualification testing but also employment security projects. The organisation reform was also aiming for an efficient administrative system and manpower development, to meet the demands of the industry.

II. Outline of Vocational Training System

1. Types of Vocational Training

Vocational Training is subdivided into two categories: public training by the central, the regional and the local governments and public organisations; and private training by in-plant training centres or authorised ones.

(1) Public vocational training

The central, the regional and the local governments or public organisations (e.g. KOMA, KCCI), provide vocational training in areas where the private sector lacks facilities or faculty.

Under the Ministry of Justice 37 public VTIs are operated in adult prisons and facilities are also available for juveniles.

Regional and Local Governments: nine Institutes provide training in the light industry and in the service trades for the young unemployed or income generating activities for indigent people.

Under the Korea Manpower Agency there are 41 Institutes. KOMA plays an important role in public vocational training. Major trades are those in which training is hard to be carried out by SMEs, such as mechanics, electrics, electronics and metal working. It also operates a technological university (Korean University of Technology and Education), which specialises in the training of vocational training instructors in four year courses.

Korea Employment Promotion Agency for the Disabled has one Institute. Training areas include precision machinery, precious metal processing, fashion design, etc. which are suitable for the characteristics of disabled persons.

The Korea Chamber of Commerce and Industry (KCCI) has eight Institutes. The institutes of KCCI provide training in machinery, electrics, electronics, information and communication, system control, etc., with partial financial support from enterprises.

(2) Private Vocational Training

In-plant Training: 223 Institutes

Enterprises are obliged to develop skilled manpower for their own needs. They establish and operate vocational training institutes by themselves to satisfy the demands for skilled manpower due to the technical innovation and changes of industrial structure.

Enterprises with more than 1,000 employees should conduct in-plant training, unless they want to pay a certain amount of money as a vocational training levy. Their types of business cover different areas from the primary to the tertiary sector.

Authorised Training: 128 Institutes

Authorised training is carried out by corporations or individuals, who are authorised by the Ministry of Labour according to the basic Vocational Training Act. They mainly provide instruction in trades where public training or in-plant training is difficult. Sometimes they conduct training on behalf of the government or an enterprise.

(2) Courses of Vocational Training

Vocational training courses can be classified into basic training, upgrade training, job conversion training and retraining according to their target groups.

- Basic Training: basic skills for a job
- Upgrade Training: higher job ability
- Job Conversion Training: qualification for a new job or for work in a different area
- Retraining: updated job competency

Course	*Access Requirement*	*Duration*
Basic training	Aged 14 years or older, admittance based on the decision of the directors	1 month or longer
Upgrade training for acquisition of qualification	Assistant craftsmen or higher qualification	4 weeks or longer
General training	Work experience of more than 6 months in the trade concerned	
Upgrade training for		3 days or longer

the improvement of job ability		
Training for manager or supervisor	Manager or supervisor with work experience of more than 6 months in the trade concerned	
Job conversion training	Change of job completed or imminent	4 weeks or longer
Retraining	Work experience of more than 1 year in the trade concerned	1 week or longer.

(1) Training Programmes of KOMA

KOMA is running training courses for master craftsmen, technicians, craftsmen, as well as upgrading courses in 19 Polytechnic Colleges and 22 VTIs.

Master Craftsmen Courses (in Polytechnic Colleges)

A master craftsman represents the highest skill attainment of a non-academically trained person. He is the middle manager between the workers at the production line and the managers. To be trained as a master craftsman, one should have 4 years experience after passing the craftsman class 1 examination. Training is provided in one or two year courses in six trades, namely machine tools, industrial equipment, automobile, welding, electrics and electronics.

Technician Courses (in Polytechnic Colleges)

A technician is a semi-engineer who has practical skills and theoretical knowledge in at least two trades. High school graduates can undergo training for two years in twenty-five trades, such as manufacturing automation, mechatronics, information and technology, industrial design, and so on.

Craftsman courses (in VTIs)

The training lasts either less than one year or two years. There are no specific requirements to be fulfilled for short-term courses. In the two year courses only high school graduates are accepted. The two year course aims for the craftsman class I qualification, the one year course for craftsman class II and 6 months course for assistant craftsman. Training trades are precious metal crafts, industrial equipment, automobile maintenance, electric control and industrial electronics, etc..

Upgrade Courses (in VTIs and in Polytechnic Colleges)

One year courses are provided for qualification holders above the assistant craftsman level in various trades. Up-grade courses require six months job experience. A worker can participate in training courses in various trades lasting for 24 hours or more.

(2) Modes of Training

The training modes can be subdivided as follows:

- Institutional training: in a vocational training institute
- On-the-job training: in the manufacturing facility of a company
- Co-operative training: combination of institutional training, on-the-job training and school education

3. Vocational Ability Development

National income has increased owing to stable economic growth, followed by a higher demand for social welfare. Employment Insurance was introduced in

July, 1995, and projects for vocational ability development have been emphasised to ensure a continuous development of ability and efficiency of workers.

The Korean government has supported vocational ability development programmes with more than 30 employees and has established vocational ability development centres in 19 Polytechnic Colleges and 22 VTIs under KOMA to promote vocational ability development projects.

The term 'vocational ability development' indicates the development and the improvement of job competency based on the Employment Insurance Act, where , as the term of vocational training indicates, basic or upgrading training is based on the Basic Vocational Training Act. Both types differ in their training target groups and their training content.

Vocational ability development aims to maintain the worker's standard of living and aims to contribute to the development of the national economy. Therefore, the Ministry of Labour takes charge of the services and supports its administration by:

Administerial Support
Policy development, guidance and management of vocational training
Initiating and supporting vocational ability development projects
Development of a vocational training plan and support for in-plant or authorised training
Planning, guidance and management of the National Technical Qualification Test
Planning and management of skill encouragement policies
Comparison between Vocational Training and Vocational Ability Development.

Classification	*Vocational Training*	*Vocational Ability Development*
Legal Base	Base Vocational Training Act	Employment Insurance Act
Application	Workers and Job-seekers	The Insured
Training objective	Job competency	Improvement of job ability
Training contents	Basic training concentrated on manufacturing	Upgrade training for ability development in various trades
Executing body	Public, in-plant, authorised training institutes	Enterprises (or consignment to training institutes)
Training duration	Long-term (6 months to 2 years)	Short-term (hours, weeks)

III. Promotion for Vocational Training

1. Development of Vocational Training Standards

The objectives for training, curriculum compilation and standards of facilities and equipment are developed and implemented for systematic and effective training, to achieve:

- Standards for efficient manpower training
- Balanced levels of vocational training in various trades
- Guidelines for the planning, organisation, guidance and management of vocational training
- Promoting workers' skills and securing their standards of living, etc.

If an occupational trade requires less than one year's training, its standards shall be developed respectively referring to the compiling guide. If it needs more than one year's training, it should observe the standards.

As of October, 1996, vocational training standards have been developed for 510 trades, i.e., short term training standards for 278 trades and long term training standards for 232 trades. At present, vocational training is provided in 232 trades:

Procedure of standards development

Preparation	Selection of potential new trades
	Final selection of trades to be developed
Survey	Collection and analysis of relevant data
	Defining the essentials of standards
Development	Preparation and review of the draft
	Drawing up the final draft
Settlement	Announcement of settlement by the Ministry of Labour

2. Development and Distribution of Vocational Training Materials and Media

In order to teach the training contents effectively which are defined by the training standards, textbooks and teaching materials are developed and distributed.

Materials published by the Government or approved by KOMA are used in basic training and job conversation training and in training courses lasting for more than 6 months. At present, theory textbooks are published for each subject whilst practical textbooks are published for training modules.

Besides, KOMA also develops computer courseware, slides and video tapes for maximum training and learning efficiency.

Vocational Training Materials Developed (as of Dec. 31, 1995.)

Classification	*Total*	*MasterCraftsman*		*Craftsman*		*Others*	
		Theory	Practice	Theory	Practice	Theory	Practice
No. of kinds	1,724	90	59	631	696	115	142

Media Developed (as of Dec. 31, 1995. Unit: kind)

Classification	Total	Computer courseware	Slide	Video	OHP	Film	Model	Audio tape
No. of kinds	341	110	99	29	73	22	7	1

IV. Vocational Competency Test and Manpower Management

1. National Technical Qualification Test

The Government evaluates and certifies the technical or skill competency level of an individual based on the National Technical Qualification Testing Act from 1973.

This system operates under the auspices of KOMA and the Korean Chamber of Commerce and Industry, supervised by the Deliberation Committee for the Technical Qualification System under the Ministry of Labour.

(1) Structure of the National Qualification

The National Qualification System consists of the engineering field, the craftsman field and the service field. The total number of trades amounts to 734 trades in 25 areas.

- Qualification levels in engineering are: engineering class II, engineering class I and professional engineer (from bottom to top).
- Qualification levels in the craftsman field are: assistant craftsman, craftsman class II, craftsman class I and master craftsman (from bottom to top).
- Qualification levels in the service field are: class III, II and I.

(2) Testing Methods and Management of Qualification Registration

Qualification tests consist of regular tests and irregular tests. Written tests and practical tests are conducted to evaluate levels of technical competency. In addition, job experience is needed for craftsman class I and professional engineer and interviews replace practical tests for professional engineers.

A successful applicant should report to the minister in charge of a certain trade. The ministry then issues a Technical Qualification Certificate Notebook to recognise his competency.

2. Promotion of Skilled Individuals

(1) Skill Promotion

The Skill Encouragement Law aiming at the development and improvement of technology and skills was made effective in 1989. It has motivated skilled workers to devote themselves to the assigned tasks with pride and dignity.

It is official policy that the central, the regional, the local governments, as well as public and private corporations should preferentially employ the qualification holders.

There are also other activities conducted, such as campaigns for the promotion of a skill-favourable "climate", support of training skills, selection of excellent craftsmen and outstanding enterprises and so on.

(2) National Vocational Training Competitions

Regional and national vocational training competitions are held every year and are aimed at encouraging skilled manpower. Medalists in the National Vocational Training Competitions receive monetary prizes and are exempted from practical tests in the craftsman class I examination. They also have an opportunity to participate in the International Skill Olympics.

(3) International Skill Olympics

Our skilled workers participated for the first time in the 16th International Skill Olympics in 1967 and won the highest number of gold medals among the participating countries in the 23d Olympics held in Utrecht in the Netherlands; subsequently, Korea has repeated her success 10 times.

Medalists in the International Skill Olympics get prize money, the Order of the Industrial Service Merit, scholarships in case of enrolment in a university, allowances for skill encouragement and an exemption from the craftsman class I examination.

V. International Exchange in Vocational Training

1.Training for Partner Countries and Technical Support Abroad

Skilled manpower has remarkably accelerated Korean economic development. Many developing countries would like to co-operate with Korea in the field of vocational training in order to learn from Korean development. Accordingly, Korea establishes various projects for the industrial and economical development of the partner countries and hands over her accumulated experiences to them.

(a) Training of Vocational Training Experts from partner Countries

Korea trains vocational training instructors, managers, technicians and officials from developing countries in the context mentioned above. For this purpose, Seoul Institute for Vocational Training in Advanced Technology (SIVAT), was established in 1989. SIVAT provides training in advanced trades of computer application like CAD/CAM and essential trades such as electronics, machinery, automotive technology, etc..

(b) Technical Support Abroad

Korea also supports vocational training institutes in the developing countries to assist the training of skilled workers. Korea has supported the establishment of the Korean-Indonesian Vocational Training Centre by $5.2 million, the Sudan Vocational Training Centre by $4.5 million, the Vietnam Vocational Training School by $5 million. The Korean support includes training equipment, experts and training in Korea.

2. Co-operation with International Organisations

Korea has strengthened her co-operation with international organisations like ILO/APSDEP, CPSC for Technical Training, APEC, UNESCO/UNEVOC and UNDP and exchanges information with these organisations in the field of vocational training.

Korea has actively participated in and organised various international conferences and seminars in the field of vocational training. In addition, Korea promotes co-operative projects like training of vocational training experts in collaboration with ILO/APSDEP and APEC for mutual development and friendship.

3. Vocational Training Projects in APEC HRD

Korea has initiated and implemented the APEC Vocational Project to contribute to the development of the global economy through growth and development in the Asian-Pacific region. The projects consists of Further Training of Vocational Training Instructors/Teachers and the Exchange of Vocational Training Information. The second APEC HRD Ministerial Meeting will be held in September, 1997, in Korea.

VI. New Vocational Training Policy

The focus of Korea's post-60s policy towards human resources was emphasised on increasing supply of manpower so as to expedite economic growth. This resulted in ineffective use and distribution of human resources. This policy revealed its flaws when imbalance in demand and supply of manpower, industrial restructuring leading to employment adjustment and discontinuity of ability development came to characterise the 90s.

Korea has had a dual vocational training system where the school provides the vocational education under the Ministry of Education while the vocational training centre gives vocational training under the Ministry of Labour. Under this system, the two (vocational education and vocational training), grew increasingly irrelevant and a systemic ability development could not take root.

In response to this, the Commission on Educational Reform was established after the civilian government was launched and the Commission prepared a plan for vocational education reform on 9 February, 1996, aiming at "The establishment of a user-oriented life-time vocational education system for the purpose of realising an open society of life-time education". The Government is pushing forward with the legislation to implement this reform plan. The contents of the legislation will be as follows:

One, "Vocational Education Training Promotion Act." This act aims to promote vocational education training by creating an environment where vocational training institutions can have autonomy and capacity to respond more flexibly to fluctuations of the labour market and to establish an administrative and financial support system.

The main point of this act is to increase relevance and synergy between vocational education and vocational training whilst acknowledging the importance of both. Vocational education training institutions will share the financial and human resources as well as related data. They will also commission companies or other participants in each industry to conduct vocational training.

Two, "Korea Vocational Ability Development Institute Act." The object of this act is to establish an institute which will be devoted to providing professional and systematic support so that its activities can vitalise vocational education training and enhance vocational ability.

The Korea Vocational Ability Development Institute Act will ensure the institute to carries out such activities as conducting studies on and developing a vocational education training policy, a certified qualification system, collecting and distributing related information and data and developing and popularising vocational training programmes.

Three, Basic Act for Certified Qualification. This act will facilitate the rearrangement of the current certified qualification system so that in the future, obtaining a certificate can earn a similarly reliable status as obtaining a diploma. This is in response to the growing importance of certificates as a medium between the labour market and vocational training.

The essence of this act is to make it easier for those who obtain certificates issued by private institutions to obtain similar certificates issued by the State by allowing them to skip all or parts of the tests conducted by the State for the certificate. The act will also enable privately run certificate issuance institutions to be established and approved by the State.

The world today is changing faster than ever, and it has been noted that securing the national competitiveness takes the top priority for Korea to weather the storm of the twenty-first century's competition which knows no boundaries. To secure the competitiveness, multifaceted efforts such as human resources development and technological innovation are under way.

Teaching with Internet and other State-of-the-Art Technologies - TWIST

The Higher Colleges of Technology developed the TWIST programme to help to bridge the gap between the existing skills and knowledge base of faculty and the skills and knowledge required to use new instructional technologies with HCT students. The specific object of TWIST was to enable teams of faculty to obtain hands-on experience in new instructional technologies, especially the Internet.

To this end, faculty developed projects with tangible outcomes which were designed so that they could be used in existing instructional programmes. The teams were given three weeks' release time to learn about and apply the technology to their project. A structured programme ran for three one-week periods during the second semester of the 1996-97 academic year. In between the one-week periods, participants were expected to continue to develop their projects along with their normal duties.

A large number of projects were approved for participation in the TWIST programme. Of those, a number presented the results of their work during the TEND 97 conference. The following papers represent some of those presentations.

The Steps Involved in Converting a College Newsletter from Print Based to Web Based Format

Janice Adams, Fraser Robinson, Kevin Garvey
Abu Dhabi Women's College
Higher Colleges of Technology, UAE

Note: What follows is a transcript of the presentation given by the *Corniche ChronicleOnLine* group at TEND 97. It essentially describes the reasons for our project and the steps involved in putting it into effect. It is not intended as a technical paper nor does it explore the wide range of possibilities for the future and the applications of these possibilities in the teaching/learning environment.

Excellencies, Delegates and Colleagues:

The opportunity to participate in the TWIST project came at just the right time in the evolution of the Abu Dhabi Women's College newsletter, *Corniche Chronicle*. TWIST—Teaching With Internet and other State of the art Technologies—suited to a tee our project to convert our newspaper from a traditional print format to an electronic format which will be accessible on the internet.

Corniche Chronicle was started in 1991 as an A4-sized, rather densely printed, mostly faculty-written newsletter. In its first year, we had only one student editor but by its third the paper had been taken over by an enthusiastic student editorial team who made it much more attractive to its readership and we expect the electronic *Corniche Chronicle OnLine* to be an even more exciting communicative activity for our student cyber-journalists.

We had begun to experience difficulties with getting our printed editions of the paper to our readership. With the start of the Certificate/Diploma programme, and of CERT and simply by virtue of population increases, Abu Dhabi Women's College has more than tripled in size since 1991. This taxed to the limit our printing and distribution system which is entirely in-house. Furthermore, because of student numbers our scheduling has usurped free time students who used to be able to devote time to editorial meetings. Converting to electronic format will alleviate many of these problems. Stories will be slotted in as they happen and material posted online as it becomes available. Rather than a whole edition having to be ready at one time, future production will be fluid and flexible and will better suit students' and instructors' tight schedules. The majority of our current production and printing problems will disappear by virtue of the fact that they are no longer applicable to the new web based format.

These benefits are icing on the cake. Our distinguished speakers on educational multimedia here at TEND '97 have pointed out the perks of electronic versus print format in student publishing. We believe that our students will be excited about seeing their writing on the internet and that *Corniche Chronicle*

OnLine's readers will enjoy the interactive facet of their new and improved college newsletter.

So far as the design of the web site itself is concerned, we began by looking at a wide range of web sites which we felt were comparable in their content or intended audience. These were predominantly newspapers, children's and educational sites. After a good deal of exploration we decided to follow the format used by *The Irish Times* newspaper site. We chose this particular site as being particularly suitable for imitation because of its overall appearance, its navigability and structure. Our reaction to *The Irish Times* web site proved prophetic in so far as the site was the recipient of a major award soon after we had adapted it as our model. This lent the project external validation and more significantly saved us from going back to the field again and again wondering if we might not have been better off with another model.

We were fortunate that, through the TWIST initiative, a workshop was given at that time on the fundamentals of Hypertext Markup Language (HTML), used extensively in web page formatting. We took advantage of that to start to understand the code and experiment with a variety of authoring tools. Research, reviews and personal recommendation from HCT's webmaster all led us to *Hot Dog Pro 3* though we did benefit from working briefly with *HotDog* and *Netscape Navigator Gold* under *Windows 95.*

Because HTML works by calling on many other files such as text files and graphics files, we soon found that there was a need for a clearly understood directory structure. So we spent quite some time sorting out the directory structure before doing the same for our complex links structure. Graphics were scanned by using a colour scanner and were output as TIF files. We then used *Corel Draw* version 6 to convert the TIF files into GIF files which are useful for pictures with spot colours and JPEG files which are more suitable for photographs.

In the near future we hope to introduce sound files using Real Audio technology which relies on a stream of data which is continuously converted into sound. Furthermore we will use video clips whenever appropriate to enhance *CornicheChronicleOnLine*.

So far as the scope and content of the new format newspaper is concerned, they can be rather conveniently summarised by the acronym NICE, wherein N stands for News, I for an Interactive site, C for the Creative page and E for the Editorial section which includes a contribution from the college Director. As a college newspaper mainly produced by students, its goal is that of publishing news, student writing and art from all sectors of the college.

The web format does away with conventional copy constraints in that new material can be added anywhere, anytime and flagged as new for the benefit of the regular reader. There is no longer a necessity to wait for 2, 4 or 6 pages of copy to be produced before a piece of work can be distributed to our readership.

Navigating the web site itself is easy. The reader simply points and clicks on an icon to go to the associated story and navigates using images and icons according to their own interests and motivations. We can link to other sites on the web from within articles just as easily by selecting hot links as appropriate.

His Excellency, the Chancellor of HCT, Sheikh Nahayan, has emphasised the importance of educational reform and the need to be flexible and responsive in our educational strategies. Jim Senn speaking here yesterday recommends that teachers should make technology an integral rather than a peripheral part of their work by doing two things in particular: a) creating a project and b) forming a team. We firmly believe our web based *Corniche Chronicle OnLine* supports learning activities which increase student motivation and promote exploration and interaction with computer based technology. Whilst visiting *Corniche Chronicle OnLine* our students can relate the skills and knowledge at a level and in a context they can easily understand. The reader progresses through the web site on their own chosen pathway, driven by their own interests and choices.

From an educational perspective the interactive features invite much greater practical and cognitive involvement on the part of the student. The online format and the e-mail software deliver a widening range of interactive features. Not least of these options is our next major goal: that of using electronic mail to encourage interactive discussion in a listserv format.

Soon to be located at Abu Dhabi Women's College web site, *Corniche Chronicle OnLine* establishes a student presence on the home page making it literally their own home-sweet-home page, a part of an ever growing international community. Our goal was that of setting up a product which will grow in time. Time has been a major constraint but with the bulk of the work now done, in terms of planning and building a web site, we will have an opportunity to add exciting features in the future. *Corniche Chronicle OnLine* goes online to be assessed on its merits and early limitations. In terms of its content and appearance however, we hope you will soon be able to visit us and that you enjoy our site.

Electronic Component Analysis and Circuit Building Via an Interactive Multimedia Web Page

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Higher Colleges of Technology, UAE

Introduction

This project developed a seamless transfer platform and a Web page for Electronic Component Analysis and Circuit Building via Interactive Multimedia (ECACIBM—pronounced Easy Ac IBM.) The realised objectives of this programme includes faculty professional development, experiential learning programmes for students, faculty, student symbiotic learning and augmentation to the HCT academic programmes.

Executive Summary

An incessant challenge faced by students of Electronics is understanding electronic components and their utilisation in circuits. Conforming to the Teaching with the Internet and other State-of-the Art Technologies (TWIST) programme, our proposed multimedia programme now assists students in understanding electronic components and circuits. The ECACIBM is based on a cornerstone Learning Outcome of ELEC 105; a first year, first level course in the HCT Electronics curriculum. The goal of this Learning Outcome is for the student to be proficient in the ubiquitous (albeit perplexing) electronic component: resistors.

This was a professional development activity; thus a team of domain specific competent practitioners developed the seamless platform transfer mechanisms, ECACIBM Web page, links, simulation exercises, testing and evaluation media. The team members developed new skills in instructional technologies, utilising known technologies in unique multimedia applications; specifically in seamless platform transfer mechanisms and the use of the Internet for educational purposes. Collaboration with students was crucial in building and simulation of the Web page.

The ECACIBM Web page has ToolBook generated links to an electronics simulation software package, which students utilise to assemble and test resistor circuits. Student learning is being evaluated via another set of links to testing and evaluation media. Links also connect the student to vendor specifications of resistors. The ECACIBM platform and Web page are also media for diffusion of knowledge.

Students are being encouraged to generate additional links; this is in addition to the experiential learning of the ECACIBM. The participatory activity will be maintaining a continuum of learning, whereby additional educational goals and performance objectives could be addressed by the Internet and Web pages.

Programme Description

Even with the best intentions, students face many challenges when learning electronics. Cogitating electronic components and electronic circuits are especially daunting to novice electronics students. They are faced with a multitude of esoteric components (Figure 1) each with its own range of values and operational characteristics. Unlike other devices, for example, electro mechanical components, an electronic component's physical movements cannot be readily observed and understood by students. In addition, they are faced with the discouraging aspects of ubiquitous defective parts, limited access to instruments, finite instructional assistance (Figures 1 & 2) and the possibility of accidents. (Weerasekera 1996.)

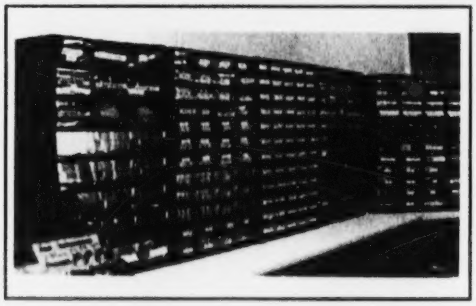

Figure 1: Multitude of esoteric Components. Defective parts, limited access.

An accident free environment with limitless fault free components is the platform we provided in this project. The actively participatory student, through the links, benefits from seamless travel to Electronics Workbench (EWB.) Utilising this world leading electronics simulation software package, the student can build an extensive variety of circuits utilising resistors.

Figure 2: Even with the best intentions, the instructor attention has to be distributed, ECA CIBM students get individualised attention.

EWB has animated demonstrations which give the student a quick overview of how to build and test a circuit. In addition, there is on screen help from the Help menu which provides instantaneous, comprehensive, context sensitive information. Compare this undivided attention to traditional pedagogy (Figure 2) one instructor, many students! The student browses through Help using its table of contents, searches for specific topics in its index, or gets specific information about a selected component or instrument. For complex circuits, there are Sample

Circuits, which include typical analogue and digital circuits. These are for the student to examine, modify and use as building blocks in other circuits. These help features are available as links from the Web page.

In addition to the individualised pedagogy, the simulation offers unlimited access to instruments, an unlimited number of resistors and negated is the possibility of shocking (pun intended) accidents, human or to the equipment. Furthermore, built-in are powerful computational tools that go well beyond what might be normally found in a "real" lab. Working in safety, the students save time, building and testing resistor circuits using the EWB. Thus, in the ELEC 105 course, we maximise our access to the "real electronics lab" (Figure 3). We make the most of our time by designing and testing circuits first with EWB. Novice students are made comfortable using the simulation software because the computer generated components are accurate. Whilst this may be an embellishment of the truth, confusion of resistor circuits can be minimised by using accurate devices; real components often do not have the values they are supposed to have. For example, a 10-KΩ resistor might not exactly be 10-KΩ, and two "identical" transistors may not be exactly the same. Since the computer generated components are accurate, the simulated values are the same as the calculated values, simplifying the learning process for students.

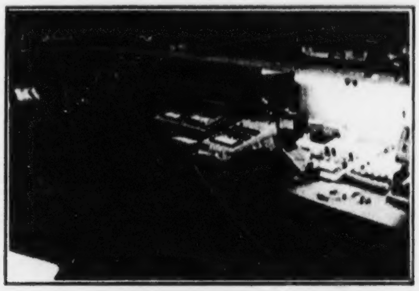

Figure 3: Maximise "real lab" usage. Novice students are more comfortable with the real lab after experimenting with simulation software.

Going from the Web page to EWB, the student opens the passive part bin containing resistors, clicks on the resistor symbol "myresistor" and drags it to the workspace. Now the student "personalises" the component, by setting labels, values and control characteristics. To wire components together, the student only needs to press and hold the left mouse button between components and a wire appears. The wiring is neat (unlike the "spaghetti bowl" of wires one normally sees in the lab!) The wires are routed at right angles, without overlapping other components or instrument icons (Figure 4). Circuits are also made neater because there are four different wire colours. In a complex circuit, coloured wires make wiring and troubleshooting easier. Also, wave forms on the oscilloscope and logic analyser are the same colour as their probes, so that the student could easily correlate the input with the resulting instrument display.

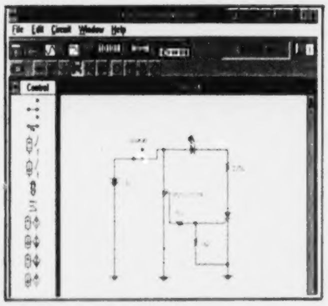

Figure 4: Easier, neater, colour

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coded schematics.

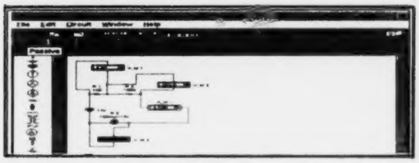
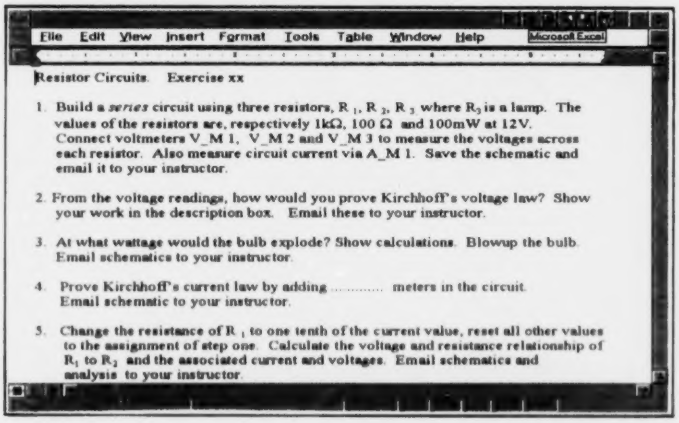


Figure 5:Circuit testing. Unlimited supply of meters.

When the student is satisfied with the construction, the next step is to test the circuit; an unlimited supply of voltmeters and ammeters is available (Figure 5). Also, there are power supplies, function generators, frequency counters and oscilloscopes for the circuit simulation. The links of the platform are used for student assessment. These are a set of exercises and circuits (Figure 6). The two electronics instructors listed in this proposal wrote the guides for the student to complete these assignments. These assignments are based on Word®, another known platform.



Resistor Circuits. Exercise xx

1. Build a *series* circuit using three resistors, R $_1$, R $_2$, R $_3$ where R_3 is a lamp. The values of the resistors are, respectively 1kΩ, 100 Ω and 100mW at 12V. Connect voltmeters V_M 1, V_M 2 and V_M 3 to measure the voltages across each resistor. Also measure circuit current via A_M 1. Save the schematic and email it to your instructor.

2. From the voltage readings, how would you prove Kirchhoff's voltage law? Show your work in the description box. Email these to your instructor.

3. At what wattage would the bulb explode? Show calculations. Blowup the bulb. Email schematics to your instructor.

4. Prove Kirchhoff's current law by adding .... meters in the circuit. Email schematic to your instructor.

5. Change the resistance of R $_1$ to one tenth of the current value, reset all other values to the assignment of step one. Calculate the voltage and resistance relationship of R_1 to R_2 and the associated current and voltages. Email schematics and analysis to your instructor.

Figure 6: Links for student assessment. An assignment to be completed by the student and e-mailed to the instructor.

Upon completing the analysis, the student will e-mail the work to the designated faculty member. Individualised and reinforcing feedback: evaluated work will be e-mailed back to the student, with remedial work, as necessary. The documentation for these communications would also be via the Web page, ToolBook links to Microsoft Word®. The aforementioned process gives the instructor and student documentation necessary for evaluating course progress and class standing.

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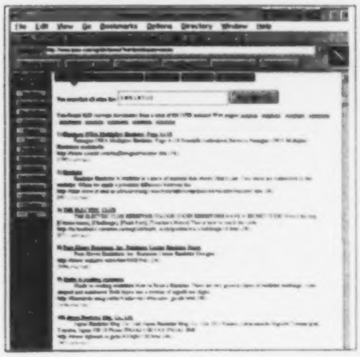

Figure 7: Students develop additional links via Internet searches.

Additional assignments were completed such that the student was an active and independent learner. These activities included developing links (Figure 7) which connect to electronic component vendors such that the students could obtain vendors' specifications of resistors.

The ECACIBM is a virtual learning environment which provides experiential learning. The student is an active participant in the learning process. Utilising captivating graphics and interactive media, the student learning is stimulated, overcoming the daunting aspects of the specific Learning Goal. This participatory, self directed learning ensures the maximum retention. We also overcome the deficiencies of traditional pedagogy: lecture and chalkboard, one instructor, many students. Using ECACIBM the instructor uses a variety of non traditional instructional approaches, such that the student learning and retention objectives are realised. The focus is therefore maintained by the team members who developed new skills in instructional technologies; specifically in the use of the Internet for educational purposes.

Conclusion

This project developed a launching platform, learning exercises, assessment activities and a Web page for electronic component analysis and circuit building via interactive multimedia. We utilised known technologies in unique multimedia applications. Goals met via this project include faculty professional development, experiential learning programmes for students, faculty-student symbiotic learning and augmentation to the HCT academic programmes.

We conformed to the goals of the TWIST programme, in that our project assists the student in learning electronic components and circuits. ECACIBM is based on a Learning Outcome goal of a first year, first level Electronics course, "students to be cognisant of resistors and resistor circuits."

The team assembled are domain specific competent practitioners. They developed the seamless platform transfer mechanisms, ECACIBM Web page, links, simulation exercises, testing and evaluation media. Essence of this exercise was also a faculty professional development activity. The team members acquired new competencies in instructional technologies, specifically in the use of the Internet for educational purposes.

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Educational goals and performance objectives addressed by this proposal are indicative of the symbiotic and innovative learning mission of the HCT academic programme team members and expertise

Gamini Weerasekera, Electronics instructor, fifteen years. CBI-CD course developer. Knowledge engineer for Expert Systems (AI) instructional programmes.

Ed McLean, Instructional experience of twenty years. Instrumental in the development of multimedia for instructional programmes. Authorware programmer and Martin Scorcese wanna-be.

Edmund Burke, Instructional experience of fifteen years. Developed vocational programmes in electronics, in an international environment. Course outline and course delivery designer.

Joseph Akbury, Instructional experience of twelve years, specialist in electronic components and has developed multimedia for instructional programmes.

References:

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Toolbook as a Multimedia Tool in Teaching and Learning

Priyan Wijeyeratne
Dubai Men's College
Higher Colleges of Technology, UAE

Summary

Multimedia is a popular tool in developing and delivering teaching and learning material. Despite the fact that a greater time is required in developing multimedia instruction compared to traditional modes, *Toolbook* provides a versatile platform within which multimedia can be developed quickly and effectively.

Toolbook has an object oriented programming environment and its user friendly drag and drop interface provides the key advantage in multimedia instruction development and delivery. This paper looks into the basics of *Toolbook* software and the experience of a team of teachers from the Civil Construction Technology Department at the Dubai Men's College, in using it as a tool for developing and delivering instruction.

Introduction

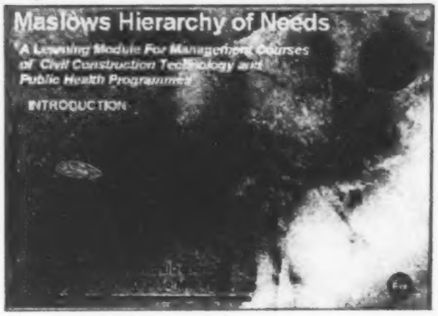
Toolbook software is produced by Asymetrix Corporation, and it has many versions. Each one has a specific advantage. *Toolbook* CBT version 4.0 has its advantages in the teaching and learning environment.

The Civil Construction Technology Department runs courses in Management for both Construction Technology and Public Health programmes. The component that deals with human motivation of these courses is known to be abstract and demands a high level of English language skills, thus making it somewhat difficult for the non English speaking audience. To redress this situation it was decided to use multimedia so that the actual amount of reading and comprehension may be kept to the minimum. *Toolbook* CBT 4.0 provided the ideal platform to create the classroom environment that was required to handle this situation.

With the above in view, a team of teachers from the Civil Construction Technology Department set out to create a teaching and learning module on "Maslow's hierarchy of needs" (see figures 1.0 and 2.0). This module consisted of a book (explained under "*Toolbook* Structure") which was a combination of two books, one for delivering lessons and the other of multiple choice questions for testing the learning process (see figures 3.0 and 4.0).

Figure 1

Figure 2



Maslows Hierarchy of Needs

A Learning Module For Management Courses of Civil Construction Technology and Public Health Programmes

INTRODUCTION

Toolbook *Structure*

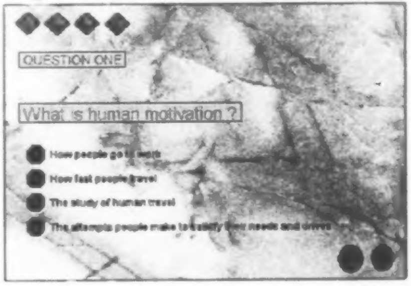
It is based on the traditional object oriented programming technique. The predetermined hierarchy of objects governs the line of message handling as initiated by the user - in this case the student. To further facilitate this environment, it has an easy drag and drop programming interface (see figures 5.0 and 6.0).

Creating a button is as simple as selecting a button icon from the tool palette and dragging it onto the drawing area of a page. Then a simple programme is required to be written, in "Open Script" language, to make it act as desired. Many more features of this type cover most of the development process.

Figure 3

Lesson 1
WORK AND LIFE

Figure 4

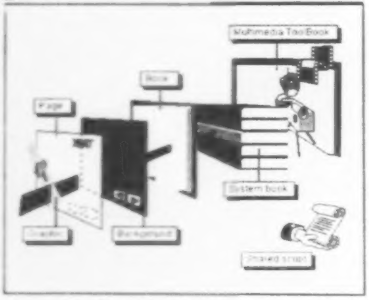


QUESTION ONE

What is human motivation ?

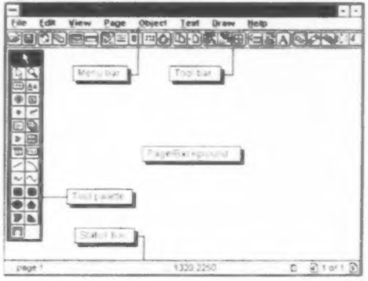
- How people go to work
- How fast people travel
- The study of human travel
- The attempts people make to satisfy their needs and drives

Figure 5



Multimedia ToolBook
Book
Page
System book
Graphic
Background
Shared script

Figure 6



File
Edit
View
Page
Object
Text
Draw
Help
Menu bar
Tool bar
Page/Background
Tool palette
Status box
page 1
1320 2250
1 of 1

A *Toolbook* application takes the form of a book. A book as usual, consists of pages. The pages can have text, buttons, graphics and animation. A book may be navigated sequentially or asymmetrically. There may be more than one book in one set of teaching and learning material.

These features of *Toolbook* and its object oriented programming base were the main attractions for the software selection. Also, to develop the application so

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that students can simply "click" and find their "way around" was possible with these in-built powers of *Toolbook* CBT 4.0.

Integrated Development Environment

To facilitate application development process and distribution, *Toolbook* provides an integrated programming platform that consists of the following entities.

- Bitmap Editor
- Menu Editor
- Wave Editor
- Book Specialist
- Digital Video Producer
- Object Catalogue
- Animator
- Course Management System
- A Collection of Resources and Examples
- Setup Manager

Each entity works independently within the one platform to make the development process easy and effective. The most advantageous of all is the course management system. This provides the leading edge in teaching and learning. Students may be assigned to one or more books. A record of students' activities may be created and checked periodically to monitor progress. The "setup manages" makes the distribution of finished software, relatively an easy task.

The object catalogue, "widget," provides a set of pre-programmed objects (graphic elements). These objects provide some common behaviour that may be used in application development with little or no modification.

Common Application Development Steps

The following are some commonly used development steps:

Collect clips, data and other resources
Create pages and book(s)
Add text, buttons, graphics and animation etc.
Programme the object to have required behaviour
Test run the application
Evaluate
Set up for distribution

Although there is no account of needs analysis and instructional design aspects in this paper, they are important parts of the development process that should be given careful consideration.

The evaluation may be divided into two parts. Firstly the software evaluation and secondly, measuring the increase in student understanding of the underlying concepts addressed in instructions delivered by the software. It may also be argued that the latter underpins the overall evaluation strategy of instructional software.

The Development Process

The development process of "Maslow's hierarchy of needs" was started by searching for a suitable video tape. It was the idea of the developers that an audio visual environment would constitute the ideal learning medium and would demand the minimum amount of reading for clear understanding. Therefore, the simplified text version of each lesson was also added as a supplement to the audio visual environment. Buttons, texts and bitmaps were then created as needed to complete the product (see figures 3.0 & 4.0).

Having created the classroom, a series of tests was formulated using multiple choice format. *Toolbook's* "widget," the pre-programmed object catalogue, was used in installing these questions. The "question widgets" are pre-programmed to provide a response to a student selection of an answer from a given set, thus providing an immediate feedback to the learner. The total score at the end of the test session may be obtained by clicking the "score" button (see figure 3.0). The students may repeat the lessons and take tests as many times as they wish to attain the total mastery of the subject.

The lessons and questions may be modified or added at anytime with great flexibility and the overall format of the book will not change. The technique known as "story boarding" was used in formulating the structure of the book. Also, it was decided to restrict the navigation pattern to guide the students through the lessons starting from the first to last. It also ensures that the lessons are taken and tested in ascending order. This navigation pattern was necessary as the lessons were dependent on each other. It may be argued that this undermines the power of *Toolbook's* hyperlink ability. This was a step that was taken to make use of the video tape that was readily available off the shelf in the Learning Resources Centre at the college. The developers believe that it would have been much better if a series of independent video clips were produced locally to highlight Maslow's theory. This would have given the opportunity to use *Toolbook's* hyperlink capability to its full scope.

After product development, an evaluation should be carried out. And any changes to the product may be done based on its outcome. The developers are hoping to utilise this application for classroom teaching and learning soon. Students' behaviour and knowledge gain will also be measured for fine tuning of the product.

Development Time

"Production of multimedia simulations and instructions is extremely time consuming as it can easily take between 50 to 200 man-hours to produce just one to two hours of instruction. Complex graphics and animation are even more time consuming as a few seconds of accurate 3D animation can take up to a week to generate" (Neiger 1997).

The above findings were confirmed by our experience in developing the module, "Maslow's Hierarchy of Needs". The interesting aspect of this was, that the same module was developed in a slightly different format and spent only a quarter of the initial development time. This confirms the possibility of reduced development time that may be achieved with experience and proper organisation in the use of *Toolbook* CBT 4.0.

Conclusion

Asymetrix *Toolbook* CBT 4.0 is a powerful multimedia tool in teaching and learning. Software development time is proven to be a major component, especially for beginners. Productivity may be increased with the experience and proper organisation of resources. The benefit of the teaching and learning module, "Maslow's hierarchy of needs" is yet to be measured and used for further development of the product.

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0 Salenger, (1980), Maslow's Hierarchy of Needs, Video tape, Salencier films and videos, 1980.

ADW TWISTERS Stir up Electronic News

Janice Adams

Abu Dhabi Women's College

Higher Colleges of Technology, UAE

The outcome of one TWIST project at Abu Dhabi Women's College (ADW) is that our college newspaper, *Corniche Chronicle*, will soon be accessible on the Intranet. It will be a permanent feature of the ADW home page at the HCT web network. There, students and everyone who wants to, will find college news, creative writing, editorials—the steadfast Rowlands Review—and interactive features mostly student produced for a mostly student readership.

The TWIST team of Fraser Robinson, Kevin Garvey, and Janice Adams worked to create the new *Corniche Chronicle OnLine*. Our TWIST (Teaching With Internet and other State-of-the-art Technologies) project was to convert the print based *Corniche Chronicle*, ADW's 6-year-old newsletter, to electronic format and to give it interactive features which would make it an active learning vehicle as well as a place for students to read and to publish their writing and other work. Students will also be able to respond as they read, via e-mail, by writing a letter to the editors, posting a comment on a bulletin board, or simply by filling in a crossword or answering a riddle. The immediacy of the electronic medium is the key to stimulating greater reader participation and we hope it will spur the urge to contribute as journalists as well.

The next step in the project is to create classroom materials where teachers can get their students started using *Corniche Chronicle OnLine*, whose primary function, after all, is to enhance learning in a "real work" context. We also hope to find software which will enable students to type their stories directly into an electronic form which will then convert them automatically to HTML code, the language of the Internet. This will give students hands-on access to the publishing process and should further encourage participation.

The Corniche Chronicle OnLine TWIST project was first shown to the world at the TEND '97 conference in April. It literally was "shown to the world" as delegates from as far as Finland, South Africa, and Australia clicked through its pages, opening up stories and widening out photos via hypertext links. If students show as keen an interest as did visitors to our demo, *Corniche Chronicle OnLine* will be a success.

Look for *Corniche Chronicle OnLine* at ADW's home page in the coming month. We hope to have the site up and running before the end of the semester. See you there, and e-mail us to let us know how you like it!

Twist Project: "Maslow's Hierarchy of Needs"

Priyan Wijeyeratne, Thomas Riordan, Peter Gehbauer, Douglas Cousino
Dubai Men's College, Civil Construction Technology
Higher Colleges of Technology, UAE

Management courses in the Civil Engineering Technology programme require some development (and suitable teaching and learning material) in human motivation aspects. Understanding human motivation theory and being able to apply this in real life situations is a useful skill. Yet the abstract nature and high level of English language skill requirements make the training task somewhat difficult. With this in view, a team of teachers set out to use multimedia to develop a teaching and learning module on "Maslow's hierarchy of needs." They hope to make it available for students' use in the first semester of the academic year 1997-98.

Audio visual medium supplemented with easy English text were selected as the knowledge transfer mode. It was the idea of the developers that students would be provided with access to the module through the Independent Learning Centre so that they could use it in their own time to prepare for classroom sessions. It will also help accelerate their subsequent learning process.

Having generated the initial thought, the developers selected Asymetrix *Toolbook* technology to develop the module and underwent self training in the use of the software. The developers confirm that it takes 100 to 200 hours of development time for just 30 to 45 minutes of instructions. Also, the time spent would have been much more if the video material was produced locally.

As seen by the development team, this module has a great potential across the college system. It has the flexibility to develop further to incorporate more material and depth without changing the original format. They hope to carry out an evaluation of the product in the coming semester and use the outcome to upgrade it appropriately.

A Web Site for Technical Report Writing

Brian Crossman, Nick Bates, Janet Lunam
Dubai Men's College
Higher Colleges of Technology, UAE

Our TWIST project was to create a web site on the HCT Intranet to assist final year technology students in their *Technical Report Writing. The* concept was that from a home page, a student could surf to an appropriate area of the site, depending on the discipline and the level. There they would find an overview, describing the situation and function of the report within the grand scheme of their studies; an outline, detailing what the content of each section of the report should be and finally a sample report. The outline and sample were linked together, section by section, so that a student could read about what a particular section of the report should be like and then see the same section in the sample by clicking on the heading. We achieved this for HD Electronics Engineering and hope to add Mechanical and Civil Engineering in the near future.

All three of us had more enthusiasm for the Internet as users rather than actual behind-the-scenes knowledge. Trying to become a web maestro is rather like learning to ride a bicycle, frustrating, a lot of wobbly attempts, bruised brains and grazed tempers. All this and sometimes very little to show at the end of hours of pecking at the keyboard. It was comforting to have Tom Palaskas, web wizards Aziz El-Mutwalli, and Anas Al Jamal as patient and helpful mentors throughout the project.

For those of you who do not have www (worldly web wisdom), making a page uses a simple programming language called HTML (HyperText Markup Language) to format the headings, add text, colours, graphics, provide links and all that magical stuff. Relatively straightforward to the cognoscenti but daunting to us at first. To aid novices there is a number of programmes available that can be downloaded from the Internet itself which create templates of HTML codes at the click of an icon. The author then simply types in text, file names etc. to create the overall page. Our programme cost US $99.95 and proved highly beneficial to us as newcomers. However, the help menu was in reality *unhelpful*, so, to come to terms with its more advanced features, we relied on books from the library and tips from our gurus.

Attendance at the TEND conference gave us an opportunity to parade our new baby and also provided us with ideas and feedback for improvement. Look out TEND 99, here we come!

If you would like to access the site, or have your students access it, please let us know and we'll tell you how to reach it.

Videoconference as a Teaching Tool

Najia Al-Ali, Farid Elyahky, Susan Fleming, Richard Day, Richard Baer
Abu Dhabi Colleges
Higher Colleges of Technology, UAE

Videoconferences are familiar to all of us through meetings and last year's annual conference. The TWIST programme from Academic Services has recently sponsored the first use of videoconferencing for HCT students. The project's aim was to use the videoconference to expose all term three CD students of the Career Orientation Courses to successful national figures in the community, to interact with and learn from them and their careers, as part of the curriculum, and all on-line on the big videoconference screen.

Two panels were set up, one for all women's colleges on March 2, which was moderated by Najia Al-Ali from Abu Dhabi Women's College and one for all men's colleges on March 4, which was moderated by Farid Elyahky from Abu Dhabi Men's College. The speakers for the Men's Colleges were:

Dr. Sulaiman Al Jassim, Director, CRMD, HCT
Ahmed Salem, Director, Abu Dhabi Television
Juma Al Salami, Businessman, Abu Dhabi

For the Women's Colleges, the speakers were:

Muna Ghanim Al Marri, Organiser, Dubai Shopping Festival
Meysoon Thani, Co-ordinator, Dubai Quality Awards Project

This was also the very first chance our students had to interact with other students in a common event and it was quite exciting to see their reaction when they or their friends were live on-line asking questions to speakers in another city.

About 80 HCT staff were involved in the organisation of the event as a huge team working together. The technical setup was also complicated and required wiring rooms in some colleges. After the event, the wiring remains.

The two videoconferences were recorded and edited on separate videotapes and copies distributed to all the CD supervisors and our moderators system-wide. Feedback regarding the effectiveness of the use of the videoconference technique was collected from both the moderators and the students themselves. The empirical results clearly prove that the experience was successful and effective and students asked for more such videoconferences to be organised.

After collecting the feedback and distributing the edited videocassettes, our project and results were summarised and displayed at the TEND Conference 1997 by means of *Powerpoint* and videocassette demonstrations.

When each college permanently has its own videoconference equipment, such events can become a normal part of teaching at the HCT.

Led by Najia Al-Ali - Abu Dhabi Women's College, the TWIST project team members were: Farid Elyahky - Abu Dhabi Men's College, Susan Fleming - Abu Dhabi Men's College, Richard Day - Academic Services, and Richard Baer - Abu Dhabi Men's College.

Learning Mathematics Through Multimedia.

Salwa Tadros, Philip Aston and Mamar Brahimi
Abu Dhabi Women's College
Higher Colleges of Technology, UAE

The project goal was to create a visually interesting and well sequenced mathematics training module for Foundations students. The areas covered are Ratios, Rates and Proportions.

The module starts off with a pre-test on fractions followed by a tutorial explaining and illustrating the concept of Ratio, before moving onto a test where students apply what they have learnt in the tutorial. At the end of the test they are given a detailed breakdown of their score (with an indication of the areas in which they failed) they are either allowed to proceed to the next section or directed back to repeat the Ratio tutorial. Upon revision of this material they do a revamped and re-sequenced Ratio tutorial.

Similarly, they proceed to sections dealing with Rates in both tutorial and test mode, finishing off with material on Proportions in tutorial and test modes. The work problems shadow very closely what the students might meet in their first and second semester Foundations exams, so it provides them with an incentive to work through the module systematically either during the semester or as pre-exam revision.

One of our aims was to make the computer based training module as visually attractive as possible using interesting pictures, video clips and text with animation. Another aim was to anchor the material in the students' own experience, drawing on examples familiar to our students. Explanations were deliberately kept simple, avoiding many of the problems of awkward phraseology and lexis found in many textbooks. Our ultimate aim was to make the training module an enjoyable, motivating experience for the Foundations students, allowing them to study at their own pace and review what they had learnt in class.

The team was pleased with the positive feedback they received from delegates at TEND 97 who viewed the material. Evaluation questionnaires are being prepared with a view to receiving more feedback from both Faculty and students and ways are being considered about how best to make the training module available to all interested parties.

Multimedia Autobiography Project

Stephan Ottewill and Alan Sparkman
Al Ain Men's College
Higher Colleges of Technology, UAE

The purpose of the Al Ain Men's College Multimedia Autobiography project was to gain experience in multimedia authoring in the process of developing a template which teachers could use to fulfil HCT Foundations English learning objectives and to familiarise students with various aspects of multimedia technology.

The project resulted in a "ready made" presentation that teachers could use to guide students in the creation of student autobiographies using their own video, audio, graphics and text. The product can be integrated with the HCT Foundations English curriculum, covering several of the course objectives, especially for writing and speaking. There are seven sections in the presentation:

1. Menu (Student's photo plus button links to other sections)
2. My Day (Automatic slide presentation with pictures and audio of descriptions)
3. Where I Live (Pictures linked to audio of descriptions)
4. An Interest (Short presentation with graphic background and video inset of student talking)
5. My Music (Portion of recording and music video)
6. Majlis (Video of student telling a story)
7. Quiz (Interactive quiz about the student for the person who views the multimedia presentation)

Stephan Ottewill and Alan Sparkman are the presentation authors. Stephan brought experience in interactive Internet programming while Alan has been involved in Materials Development for the Foundations and CD programmes and has encouraged his students to use technology in their writing assignments. Both actively involve their students in multimedia production in the classroom.

Biographies

HE Sheikh Nahayan Mabarak Al Nahayan

HE Sheikh Nahayan Mabarak Al Nahayan is the inspiration behind the Higher Colleges of Technology having made a commitment in 1985 to have established a system of technical education at the tertiary level for UAE nationals. The Higher Colleges were set up in 1988 and Sheikh Nahayan has been Chancellor since then.

Sheikh Nahayan has also been Chancellor of the UAE University since 1978 and Minister for Higher Education and Scientific Research since 1992.

As Chancellor, Sheikh Nahayan maintains a close and active involvement with all aspects of the life of the HCT. He also plays a direct role in the setting of annual objectives for the institution.

HE Mohamed Ali Al Abbar, Director- General of the Economic Development Department, Government of Dubai.

Mr. Al Abbar graduated in 1981 from Seattle University in the USA with a BA in Finance and Business Administration and undertook extensive training at the International Monetary Fund in 1984.

His job involves strategic formulation and planning of Dubai's economy, including preparation and implementation of programmes, monitoring government investment, preparation of studies of the feasibility of particular economic, commercial and industrial projects, and preparation of legislation relative to economic and commercial activities.

In addition to his work with the Economic Development Department, Mr. Al Abbar is Vice Chairman of Dubai Aluminium Company Limited, Vice Chairman of Dubai World Trade Centre, a Board Member of Dubai Commerce and Tourism Promotion Board, a Board Member of Dubai Cable Company, Deputy Chairman of Emirates Explosives LLC, Chairman of Rashid Pediatric Therapy Centre, Chairman of UAE Golf Association and Board Member of Dubai Investment Company.

Dr. Mohammed bin Hafeidh bin Ali Al Dhahab, Deputy President, Vocational Training Authority, Oman.

Dr. Al Dhahab has studied in Egypt and in the United States where he obtained his Doctorate in higher education administration and planning.

He worked as an assistant lecturer and lecturer at the Sultan Qaboos University and the College of Education and Islamic Sciences in Oman. From 1990 to 1993, Dr. Al Dhahab was Director-General of the Muscat Technical Industrial College and, since then, has been with the Vocational Training Authority. Dr. Al Dhahab took over as Deputy President of the Authority in September, 1994.

Dr. Al Dhahab has participated actively in a number of conferences and seminars dealing with technological education at the local, regional and international levels.

Mrs. Bahia Al Hariri, Member of the Lebanese Parliament.

Mrs. Al Hariri has had a long involvement with education in Lebanon and is responsible for a number of significant developments around her native Sidon, including pre-schools and health and social services centres and a public library and sports complex. After working as a teacher in southern Lebanon, Mrs. Al Hariri was elected to Parliament in 1992 and was quickly elected to the Chairmanship of the Parliamentary Education Committee.

Mrs. Al Hariri is Trustee of the Lebanese University of Beirut, Chairman of the Hariri Foundation, which assists Lebanese wishing to do advanced study overseas, the founder and General Chief of the Lebanese Future Scouts Society and Chairman of the Sidon Heritage and Environment Society.

Mr. Anis Al Jallaf, Managing Director and Chief Executive Officer of Emirates Bank International

Mr. Al Jallaf has a BSc in Management from Indiana University.

He began his career with the Abu Dhabi Fund and was the Founder Chief Executive of Emirates Industrial Bank, an institution funding industrial development in the UAE. He was then appointed a Director of Emirates Bank International before assuming his current position.

In addition, Mr. Al Jallaf holds many other important posts including that of Chairman of Dubai Investments, Union Properties PJSC, a leading real estate company, and Network International LLC, a card services company having the local franchise for Visa, MasterCard and the Bank's own proprietary Network card.

Mr. Al Jallaf is Vice-Chairman of Al Khaleej Investments (Singapore) which manages prestigious commercial property in Singapore. He is Director of Dubai Electricity and Water Authority, Dubai Chamber of Commerce and Industry, Emirates Industrial Bank and the Arab Insurance Group, Bahrain.

Mr. Al Jallaf is a member of the Board of Governors of the Emirates International Forum, the Regional Think Tank bringing together, eminent regional & international business leaders and experts in sectors such as banking, finance, trade, industry, tourism and services. He is a member of the Board of Trustees of the Arab Academy for Banking & Financial Studies based in Jordan and Cairo.

Mr. Al Jallaf is Education Chairman and the incoming Chairman of the UAE Chapter of the Young President's Organisation. In addition he is founder Board Member of the World Trade Club affiliated to the Dubai World Trade Centre. He was elected "Global Leader for Tomorrow" by the World Economic Forum, in 1994.

As Managing Director and Chief Executive Officer of Emirates Bank International, Mr. Al Jallaf presides over an organisation which is ranked first in terms of profits and third in terms of total assets amongst banks operating in the UAE.

HE Dr. Hanan Ashrawi, Minister of Higher Education, the Palestinian Authority, and member for Jerusalem of the Palestinian Legislative Council.

Dr. Ashrawi is one of the best known champions of Palestinian rights, having achieved international prominence as the official spokeswoman at the Madrid conference on the Middle East from 1991 to 1993.

Dr. Ashrawi has a background in the humanities, with a PhD in mediaeval and comparative English literature from the University of Virginia. In addition to being an independent-minded and tireless worker for Palestinian rights, she is a proponent of women's and children's issues and serves on many advisory boards dealing with Middle East and social issues.

Dr. Ashrawi has written extensively, including This Side of Peace: a Personal Account and numerous books on literature.

Mr. Gordon Beaumont, Chairman, Alfred McAlpine Pension Trustees Ltd. and Governor, King's School, Chester, UK.

Mr. Beaumont has been closely involved in human resourses issues since 1956 when he was appointed Personnel Manager for Fisons Ltd. in the UK. Since then, he has worked in the personnel area for a number of British companies. In 1992, Mr. Beaumont was appointed Chairman of Alfred McAlpine Pension Trustees Ltd..

Mr. Beaumont has served on various Federation Industrial Relations and Training Committees, on the National Training Awards Panel and the CBI's NW Regional Council Employment and Training Advisory Group and Training Policy Group. He was the Chairman of the report to the British Cabinet on NVQ/SVQ (the Beaumont Report) and is currently working for the British Government as Chairman of the 'National Training Organisation Recognition Panel'.

Mr. Beaumont is a Governor and Chairman of the Finance and General Purposes Committee of the King's School, Chester.

Dr. John Bowden, Professor of Education Development and Director of the Educational Programme Improvement Group, Royal Melbourne Institute of Technology.

Professor Bowden's research interests cover educational quality assurance and development in higher education, academic management and professional competence. He has written over 100 academic publications and has been a principal investigator in a number of research teams, including a number of government-funded projects.

He has been President of a number of Australian professional associations, including the Higher Education R&D Society of Australasia, the Australian Society for Computers in Learning in Tertiary Education and the Federation of Australian Social Science Organisations.

Patrick Boyle, Head of the Quality Development Group, Vice-Chancellor's Office, in the Higher Colleges of Technology.

In the last 10 years, in Australia and elsewhere, Mr. Boyle has initiated and led many major projects in quality development, mainly in educational institutions, with a particular emphasis on evaluation and quality assurance in teaching and learning. While at the Australian National University (1992-94), he directed a major federal government funded project "Quality Management and Evaluation in Teaching and Learning". He also developed that University's new and highly commended student evaluation of teaching system.

In the last decade Mr. Boyle has been invited to make presentations or carry out consultancy work in many countries, including Canada, China, Hong Kong, Malaysia, New Zealand, the United Kingdom and the United States, as well as his home country, Australia. In his current position he is helping to build a best practice based approach to quality development in the Higher Colleges of Technology.

Mr. Boyle is the author or co-author of numerous works, including books and book chapters, journal articles and papers, and commissioned reports.

Dr. Thomas J. Connolly, Dean of Aviation Technology and Professor of Aeronautical Science.

Dr. Connolly is responsible for the supervision and co-ordination of the aviation academic programme with specific emphasis on technical areas of study.

Dr. Connolly has served as the President of the University Aviation Association and in 1996 won the Association's Brewer Trophy for outstanding contributions to aviation and aerospace education.

Graham Elliott, Director, Embry-Riddle Language Institute Embry-Riddle Aeronautical University Daytona Beach, Florida, USA.

Mr. Elliott trained as a teacher in New Zealand and completed graduate studies at the University of London in TEFL and educational planning and at the University of Hawaii in Education. His involvement in technical language teaching and testing covers six countries and 25 years.

In 1994 he established an intensive English programme at Embry-Riddle Aeronautical University providing courses which link in-class activities directly to educational goals and industrial training targets. From the university, Mr. Elliott has transferred this English training approach to serve commercial contract clients where they address the safety issue of language proficiency in global aviation.

In 1988, Mr. Elliot founded a company in Boulder, Colorado which specialised in English consulting and training. He worked with major Asian, European, and U.S. aviation clients, and universities, governmental and training organisations.

He has worked in New Zealand, Australia, the United Kingdom, the United States, Saudi Arabia, and Singapore with many nationalities and with populations that range from political refugees to senior government officials.

HE Dr. Ali Fakhro, Ambassador of Bahrain to France.

Dr. Fakhro trained in medicine in Lebanon and the USA. For 10 years he worked in the health field in Bahrain, including as head of the Bahrain Health Department. From 1971 to 1982, he served as Minister of Health and from 1982 to 1995, was Minister of Education.

Over the years, Dr. Fakhro served with the Red Crescent Society, the Council of Arab Ministers of Health, the Executive Board of UNESCO and the WHO and the High Council of the Arab Board of Medical Specialists. He has also served as a Trustee for the Bahrain Centre for Studies and Research and the Arab Child Development Organisation, as Chairman of the Board of Directors of the Arabic Encyclopaedia and of the Arabian Gulf University in Bahrain and a member of the WHO Committee on the Arabisation of Health and Medical Sciences.

Dr. Fakhro has received many accolades for his work. He has been awarded the WHO Shousha Foundation Prize and Medal, the American University of Beirut Gold Medal for services in the health field, the UNESCO Silver Medal and the First Class Medal of Bahrain. He has lectured and written widely on the areas of health, education and culture.

Dr. Maurice Gross, Professor of Chemistry and Director of the Laboratoire d' Electrochimie et de Chimie Physique, Universite Louis Pasteur, Strasbourg.

Professor Gross has doctorates in the Physical Chemistry of Solids and in Electrochemistry. He has been involved in many international collaborative research projects which have resulted in more than 160 published papers.

He has also been involved as a consultant, expert adviser or project leader in many countries. This has included work on higher education in developing countries, including such areas as needs assessments, elaboration of designed training curricula and preparation of collaborative proposals to match the requirements for World Bank and Asian Development Bank loans.

Jeff Gunningham, Director, Abu Dhabi Men's College, Higher Colleges of Technology, UAE.

Mr. Gunbningham worked for 15 years in the Technical and Further Education system (TAFE) in Western Australia (WA). He was Director and CEO of Karratha College in the north-west of WA where he worked to develop relations with regional industry and commerce. Mr. Gunningham then spent 2 years as Director of the Central Metropolitan College of the WA TAFE, where he was involved in using technologies such as video-conferencing,computer-managed and computer-assisted learning and in exploiting local resources and expertise to make training programmes relevant and cost-effective.

Before coming to the HCT in July, 1996, Mr. Gunningham worked in the WA Department of Training, as Director, Strategic Planning, Training Providers Division. In this role, he was involved in a number of significant initiatives, including the reshaping of TAFE in WA into an integrated, autonomous college system.

Dr. John Hedberg, Associate Professor, Information Technology in Education, Associate Dean and Head of the Graduate School of Education, University of Wollongong.

Dr. Hedberg's current research is into navigation, cognition and design in interactive multi-media. He has been involved as an instructional designer and evaluator on many media and computer-based teaching materials, including the award-winning "Investigating Lake Iluka", a CD-ROM designed to teach ecological concepts, "Exploring the Nardoo", a river management CD and "Ask the Workers", the first interactive video-disc designed to teach career education in Australian schools.

Dr. Hedberg has served as President and Board Member, International Division, Association for Educational Communications and Technology", National President and Council Member, Australian Society for Educational Technology, Professional Member of the Library Association of Australia, Board Member of the journal "Studies in Continuing Education" and Board Member and Managing Editor, "Australian Journal of Continuing Education".

Mr. John Hillier, Chief Executive, National Council for Vocational Qualifications

John Hillier has been Chief Executive at NCVQ since 1 August 1991; he joined the NCVQ as Director of Accreditation followed by the post of Deputy Chief Executive.

He worked for many years in the glass, steel and tobacco industries, and in training and development consultancy. He contributed to the NCVQ's work from the outset through his membership of a number of lead bodies concerned with developing standards of competence on which NVQs are based. He also played a major part in setting up the National Council of Industry Training Organisations and was its first Chairman.

Under John Hillier's direction, the development, accreditation and quality assurance activities of the NCVQ have been expanded and reorganised to produce accelerated and convincing progress. NVQs exist for four out of five of the workforce, and over a million have been awarded; GNVQs are being successfully operated in over 2000 schools and colleges, and are proving a popular and successful alternative for young people, with over 25% of sixteen year olds now choosing them.

Dr. Tayeb Kamali, Managing Director, Centre of Excellence for Applied Research and Training (CERT), Higher Colleges of Technology, UAE.

Dr. Kamali obtained BSc degrees in Aeronautical Engineering and Aircraft Engineering in 1980 from Embry-Riddle Aeronautical University in the USA. He also obtained an MBA from that University. In 1989, he gained his PhD from George Washington University.

Dr. Kamali has been with the Higher Colleges of Technology since 1990 when he was appointed Supervisor of the Abu Dhabi Men's College Aviation Programme. In 1991, he became Dean of Engineering at Abu Dhabi Men's College and in 1995 was Acting Director of that College.

Dr. Kamali has been associated with CERT since its inception in 1995. He was Head of CERT until his appointment as Managing Director last year.

Dr. Gert Loose, Adviser to the President, Oman Vocational Training Authority.

Dr. Loose was educated in Germany and the United States. He has studied extensively the international aspects of technological education, including issues affecting technological teaching and training.

Over the years, Dr. Loose has worked in universities in the United States and Germany and as a consultant for international organisations, such as UNESCO and the UN Development Programme. Before taking up his current position, Dr. Loose served in the General Organisation for Technical Education and Vocational Training, Saudi Arabia, and the Division of Planning and Development in Vocational Education, GTZ, Germany.

Dr. Loose has participated in many international conferences and seminars on engineering and technological training issues.

Dr. Mary Jane Mahony, Head of Research and Postgraduate Studies, Orange Agricultural College, University of Sydney, Australia.

Dr. Mahony combines an MS in botany from the University of California at Davis, USA, and a range of experience in agricultural research with a PhD in education policy from the University of Wollongong in Australia and a history of educational development and delivery experience. This provides her with both a multi-disciplinary background and experience which enable her to look at educational issues from a variety of perspectives.

Before taking up her current position, Dr. Mahony worked at the Tasmanian College of Advanced Education and the Commonwealth Science and Industrial Research Organisation in Australia. Her overseas experience includes lecturing at the University of Agriculture in Malaysia and professional development work in southern Africa.

Dr. Mahony has been involved in higher education as both teacher and academic developer. Her interest in the use of technology in education is primarily focused on communication technologies - the application of audio, video and computer mediated communication to support education and management activities. Thanks to the Internet, Dr. Mahony considers herself an active member of a global community of teachers and researchers.

Dr. Mahony has been particularly active in the Australian and South Pacific External Studies Association and the Australian Open Learning Network. She recently completed three years on the Australian Institute of Agricultural Science Committee for Promotion of Learning in Agriculture, the last two as Chair. She is also a member of the Australian Farm Management Society.

Dr. Mahony's research interests include policy processes in agriculture and distance education, peer appraisal of distance learning materials, the development of undergraduate and postgraduate literacy and learning and research skills in distance learners.

Originally from the United States, Dr. Mahony has lived in Australia since 1975.

HE Mr. Elifa Ngoma, Secretary-General, Commonwealth Association of Polytechnics in Africa.

Mr. Ngoma is trained in public administration, sociology and technical education. He has worked as the Principal of the Evelyn Hone College of Applied Arts and Commerce in Lusaka, Zambia, and of the Zambia Institute of Technology in Kitwe. From 1990 to 1994, he worked for the Zambian Department of Technical Education and Vocational Training, first as Assistant Director for the Administration of Technical Colleges and then as the Deputy Director and Acting Director of the Department.

Mr. Ngoma has written numerous articles and papers on technical education.

Baroness Perry of Southwark, President, Lucy Cavendish College, Cambridge University.

Baroness Perry has a background as a secondary school teacher and university lecturer in the UK, US and Canada. From 1970-86 she worked as HM Inspector of Schools and then took over as Director of the Southbank Polytechnic, then Vice-Chancellor of Southbank University. She took up her current position in 1994.

Baroness Perry has been involved in many advisory bodies including the British Council's Committee on International Co-operation in Higher Education, the national Advisory Council on Education and Training Targets, the Prime Minister's Advisory Panel on the Citizen's Charter and the House of Lords Select Committee on Science and Technology.

Baroness Perry has written extensively including, "Case Studies in Teaching", "Public Accountability and Quality Control in Higher Education", "the Future of Higher Education", "What is Quality in Higher Education?" and "Education in the Age of Information". She has also contributed to many educational journals and to radio and television programmes.

Baroness Perry has received many honours associated with her activities and was created a Life Peer in 1991.

Dr. James A. Senn, Professor of Information Systems, Director, Information Technology Management, Georgia State University, USA

Dr. Senn is known internationally as a dynamic speaker on management, business transformation, corporate strategy, and information technology. He is director of the Information Technology Management Group (INTEG), a well-known research group that facilitates and promotes research and communication among information systems professionals, executives, and organization managers.

Dr. Senn recently completed a six-year assignment as Chairman of the Department of Computer Information Systems at Georgia State University. Under his direction, the department gained widespread international recognition for its programmes and activities. It received an overall national ranking by Computerworld as the number two programmes in the United States (second only to the Massachusetts Institute of Technology) and has been identified as having the top curriculum in the nation.

Dr. Senn interacts widely with businesses in many countries and is a highly-regarded facilitator at corporate and technology planning sessions and frequent interviewer of leaders and executives.

Professor Keith Short, Deputy Vice-Chancellor, Nottingham Trent University

Dr. Short graduated in Biology and obtained his PhD in Plant Biochemistry from the University of Wales, UK. This was followed by research fellowships at Harvard University, Nottingham University and University of California, Irvine. Subsequently he has held posts in Universities and polytechnics in the UK and Ireland before being appointed Boots Professor of Life Sciences at Nottingham Polytechnic in 1983. He became Dean of Science in 1985, Director of Academic Programmes in 1988 and Deputy Vice-Chancellor in 1992. At Nottingham Trent University he has responsibility for Academic and Strategic Planning, Academic Programmes, Quality Assurance and Academic Services.

Dr. Short's particular interests are in Higher Education Policy - Quality Assurance, Academic Audit and Quality Assesment, Research Policy and Assesment and International Education. He is a member of national and international groups concerned with Quality Assurance and Academic Standards and is a member of key research policy and funding organisations in the UK. He has interests in Science Education and was awarded a Masters in Science Education from London University in 1979. His research is centered on the genetic manipulation of plant cells, publishing over 80 research papers in plant biotechnology.

Dr. David Stern, Director, National Centre for Research in Vocational Education, University of California at Berkeley.

Dr. Stern has been at Berkeley since 1976 when he was appointed Assistant Professor, Faculty of Education. He became Professor in the School of Education in 1990 and was appointed to be Director of the National Centre for Research in Vocational Education in 1995. From 1993 to 1994, Dr. Stern took leave from Berkeley to work as Principal Administrator, Centre for Educational Research and Innovation in the OECD.

Dr. Stern has written extensively on work experience for students, vocational education, secondary school programmes, labour economics and school finance, efficiency and equity in education.

Sir William Stubbs, Rector, the London Institute.

Sir William has been Rector of the London Institute since 1966. The London Institute is the largest body providing education and training activities in art, design and related areas in Europe. Until joining the London Institute, Sir William was Chief Executive of the UK Further Education Funding Council and before that, of the Polytechnics and Colleges Funding Council, in which roles he was directly involved in the welfare of the tertiary education system in the UK.

Sir William serves on the UK National Committee of Enquiry into Higher Education, is Chairman of the CBI Education Foundation and is a Member of the Careers Research and Advisory Council. Sir William is also a Fellow of the Royal Society of Arts.

Professor S. P. Sukhatme, Director and Professor of Mechanical Engineering, Indian Institute of Technology, Mombai.

Professor Sukhatme is a graduate of Banaras Hindu University and of MIT, where he obtained his Doctorate of Science. He has worked in the United States (with Dynatech) and, since 1970 has been Professor of Mechanical Engineering at the Indian Institute of Technology.

From 1982 to 1983, Professor Sukhatme was Visiting Professor, Mechanical Engineering, Iowa State University, and in 1985 he became Director of the Indian Institute of Technology in Mombai.

Professor Sukhatme is a member of a number of high level committees associated with development and technology, with industrial engineering and with atomic energy.

Professor Sukhatme has received many honours for his work, including being elected Fellow of the Indian Academy of Sciences, the Indian National Academy of Engineering and the Indian National Science Academy. In addition, he is a member of professional associations, such as the American Society of Mechanical Engineers and the Indian Society for Technical Education.

Professor Sukhatme has written extensively in a variety of academic journals, especially on his areas of specialisation - heat transfer and solar energy.

Dr. D. R. F. Taylor, Professor of Geography and International Affairs at Carleton University, Canada.

Professor Taylor received his PhD in Geography from Edinburgh University and did post graduate work at the Universities of London and Harvard. He has had extensive experience in developing nations, including six years as an education officer in Kenya. His research interests include Development Studies with special reference to Africa, China and Latin America, regional and rural development theory and practice, sustainable development and indigenous development strategies, technology transfer in the field of geomatics and Canada's Overseas Development Assistance policies and technology transfer.

His recent publications include the "Electronic National Economic Atlas of China", " the hard copy National Economic Atlas of China" (Advisor and Editor, English Language Version), "Visualisation in Modern Cartography" (ed.) and "Development from Within: Survival in Rural Africa" (ed.). He is an editorial board member for several learned journals.

Dr. Taylor was Secretary-Treasurer of the Canadian Association of African Studies for 15 years and served two terms as President of the Canadian Cartographic Association. He also served on the Canadian Commission for UNESCO. He was Vice-President then President of the International Cartographic Association from 1984-95 and currently holds the position of Past President. He was also the President of the International Union for Surveys and Mapping from 1989-93.

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Dr. Taylor also holds the positions of Assistant Vice-President International, Director of Carleton International, Faculty of Graduate Studies and Research, Director of the Centre for Research Development and Training and Director of the Geomatics and Cartographic Research Unit at Carleton University.

Dr. N. Varaprasad, Principal and Chief Executive Officer, Temasek Polytechnic, Singapore.

Temasek was established in 1990 and is now a world-class institution for the training of para-professionals in a wide range of disciplines, including business, engineering, design, information technology and applied sciences. The Polytechnic aims to pursue innovative teaching methods and to maintain market responsiveness.

Dr. Varaprasad was trained as an engineer and has been working as a lecturer, associate professor and administrator at the tertiary level since 1972. Since 1985, Dr. Varaprasad has been working in senior management roles. He was closely involved in the planning for and establishment of the Temasek Polytechnic

In 1996, the Government of Singapore awarded Dr. Varaprasad the Public Administration Medal (Gold) for his services.

Dr. Kobus Vorster, Dean, Faculty of Engineering, Technikon University, South Africa.

Dr. Vorster's academic training is in applied mathematics and civil engineering, including his PhD for the University of Witwaterstrand. He has lectured on mathematics and soil mechanics at Technikon University until taking up his current role as Dean of Engineering.

Although not currently involved in teaching, Dr. Vorster manages to combine his research activities with the supervision of post-graduate students and is keenly intrested in the opening of careers in engineering for students in developing countries.

Dr. Ted Wall, Dean of Education, McGill University, Canada. Dr. Wall received a BEd (PE) degree in 1964 and an MA (Education) in 1968 from McGill.

After teaching six years at McGill, Dr. Wall completed his PhD at the University of Alberta. Dr. Wall then served as Chair of the Department of Physical Education and Sports Studies as well as the Associate Dean of the Faculty of Education and Recreation. In 1986, Dr. Wall returned to McGill as Chair of the Department of Physical Education and in July, 1991, he was named Dean of the Faculty of Education and re-appointed for a second five year term in 1996.

Dr. Wall has been active in many professional organisations. For the past three years he has chaired the Canadian Association of Deans of Education. He has also been active as a member of the Executive of the SchoolNet Advisory Board (Industry Canada) where he was Chair of the Subcommittee on Training, Research and Evaluation. Dr. Wall also is the Chair of the McGill Senate

Committee on the Educational Uses of Instructional Technology. He has been an active advocate for the wise use of technology in support of teaching and learning.

Dr. Chihiro Watanabe, Professor, Department of Industrial Engineering and Management, Tokyo Institute of Technology.

Dr. Watanabe received a Bachelor in Engineering (urban planning) degree from Tokyo University. He subsequently received his PhD from the same institution.

Professor Watanabe joined the Japanese Ministry of International Trade and Industry (MITI) in 1968 and, over the years, worked on industrial policy, industrial technology policy and energy and environmental policies. He became Deputy Director-General of Technology at MITI.

Dr. Watanabe is now Professor in the Department of Industrial Engineering and Management at the Tokyo Institute of Technology and Senior Advisor on Technology to the Director of the International Institute for Applied Systems Analysis. He has served as a member of the Science and Technology Advisory Panel of the United Nations Global Environment Facility, Adjunct Professor of the Institute of Advanced Studies at the United Nations University and Chairman of the International Energy Agency's End-Use Technology Working Party.

Dr. Watanabe has written extensively on the areas of technology, energy and the environment.

John Watson, Vice-Chancellor, the Higher Colleges of Technology, the United Arab Emirates.

Born in England, Mr. Watson moved to Ontario at the age of 4. He obtained his BSc with the Royal Military College and served as an Officer with the Royal Canadian Corps of Signals, Canadian Armed Forces. In 1969, he began his move west and worked for the University of Alberta and Ministry of Labour in Edmonton. His MBA was earned at the University of Alberta in 1975.

Mr. Watson took up this position in 1995 after being the President of the British Columbia Institute of Technology from 1989. Prior to that, he resided in Victoria, British Columbia, where he was Assistant Deputy Minister, Ministry of Advanced Education. He also spent several years in Kelowna where he held senior administrative positions with Okanagan College.

Mr. Watson served on several Boards and was Chair, Council of Chief Executive Officers, and Vice President, Advanced Education Council of British Columbia.

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